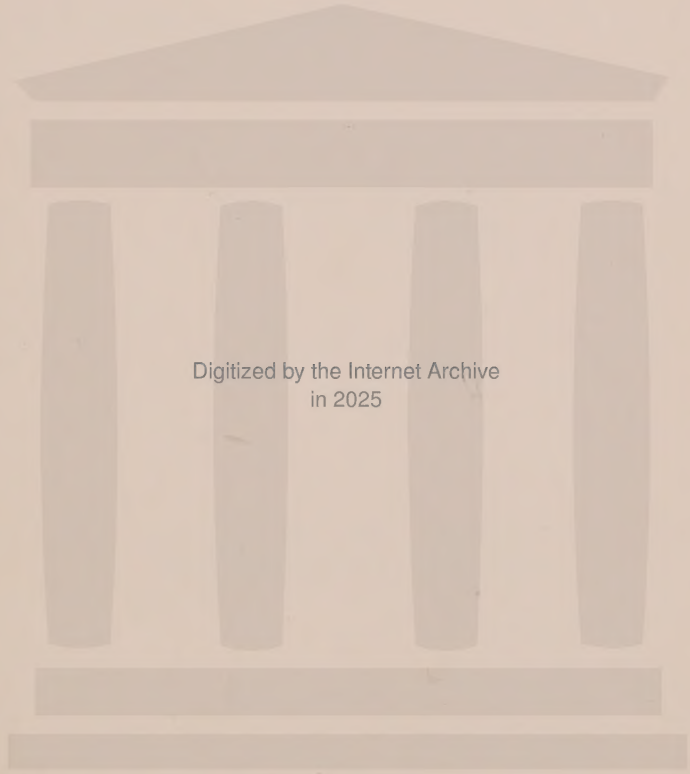
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IMPERIAL INSTITUTE OF ENTOMOLOGY.

REVIEW
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SERIES B.

VOL. 34. 1946.

DAVIS (W. A.) & HANSENS (E. J.). **Bionomics of Pediculosis Capitis. I.—Experiments in rearing human Lice on the Rabbit.**—*Amer. J. Hyg.* **41** no. 1 pp. 1–4, 3 refs. Lancaster, Pa., 1945.

A review of the literature having failed to reveal an instance of the rearing of a complete generation of *Pediculus humanus*, L., on an animal without a meal of human blood, the authors attempted to rear human body lice on a rabbit. The animal was held on its back, and the lice were allowed to feed under a cloth on a shaved area on its abdomen for about 30 minutes three times a day on weekdays and once on Sundays. Between feeds, the cloth with the lice on it was kept at 29°C. [84·2°F.] and a relative humidity of about 50 per cent. Most of the lice fed at every opportunity, and although mortality was high in the first few days, two successive generations were reared with rabbit blood as the only food. If the lice were fed less frequently or shaving was not thorough and frequent, results were unsuccessful, and lice could not feed on the shaven or unshaven ear of the rabbit. Lice fed on rabbit developed more slowly than a similar group fed on man, but there were no obvious anatomical differences. Experiments in which lice were transferred from man to rabbit and rabbit to man showed that it was possible for them to survive under such conditions, and did not support the hypothesis that the digestive enzymes of the louse are developed to act on the blood taken at its first meal.

HANSENS (E. J.). **Bionomics of Pediculosis Capitis. II.—Further Studies of a Treatment for Pediculosis Capitis with Phenyl Cellosolve.**—*Amer. J. Hyg.* **41** no. 1 pp. 5–6, 2 refs. Lancaster, Pa., 1945.

Laboratory studies made during the summer of 1943 having indicated that the concentration of phenyl cellosolve [ethylene glycol monophenyl ether] in a lotion recommended by other workers [*cf. R.A.E.*, B **33** 30] for the control of head lice [*Pediculus humanus capitis*, Deg.] might be considerably reduced, tests with lotions containing 20, 10 and 5 per cent. phenyl cellosolve, respectively, were carried out on the heads of school children in New Jersey. The hair was thoroughly wetted with 5–50 ml. of the lotion and then allowed to dry in the open air. At least four hours were allowed to elapse before a shampoo was given. Examinations made one day, one week and three weeks after treatment showed that all living lice and all eggs were killed by all three concentrations. The composition of the weakest lotion was 5 per cent. phenyl

cellosolve, 37·5 per cent. alcohol, 56·5 per cent. water, 0·9 per cent. methyl salicylate and 0·1 per cent. of a detergent. No toxic effects were noted with any of the lotions.

WILLIAMS (R. W.). **A Check List of the Mite Vectors and Animal Reservoirs of Tsutsugamushi Disease.**—*Amer. J. trop. Med.* **24** no. 6 pp. 355–357, 20 refs. Baltimore, Md., 1944.

Lists are given of the mites that have been recorded in the literature as transmitting tsutsugamushi disease (with which rural typhus, scrub typhus and mite fever are considered identical [*cf. R.A.E.*, B **30** 53]) in Australia, China, Formosa, India, Japan, Malaya, New Guinea, the Pescadores Islands and Sumatra, and of the small mammals that have been recorded as probable or proved reservoirs of the infection in all these countries except China, together with notes on the nomenclature and geographical distribution of the disease, the way in which it is transmitted, and the habits of the mites.

IRONS (J. V.), BOHLS (S. W.), THURMAN jr. (D. C.) & MCGREGOR (T.). **Probable Rôle of the Cat Flea, *Ctenocephalides felis*, in Transmission of Murine Typhus.**—*Amer. J. trop. Med.* **24** no. 6 pp. 359–362, 9 refs. Baltimore, Md., 1944.

As it appeared that cases of murine typhus that occurred in November 1942 in the three members of a family in Texas had been acquired from a kitten that had been introduced into the house from a store and had then been destroyed, its two litter mates were examined, and some 200 fleas, all *Ctenocephalides felis*, Bch., were removed from them. Inoculation of rats and two male guineapigs with suspensions of two pools of 55 fleas each resulted in the development of typical murine typhus in the two guineapigs and in others inoculated with suspensions of brains of inoculated rats. The results obtained with a third, similar pool of fleas and with a pool of flea eggs were negative. Blood samples from the kittens reacted negatively in the Weil-Felix test, and suspensions of kitten brains and spleens failed to infect male guineapigs. In the course of the experiments, the attention of the authors was drawn to another case of typhus in a woman who had also recently obtained kittens heavily infested with fleas from the store and had been frequently bitten by their fleas. In December, a bacteriologist who assisted in the authors' investigations developed a mild infection, probably as a result of contact with the infected fleas with which she had worked. Attempts to infect fresh kittens by inoculation of material from infected guineapigs were unsuccessful, negative results being obtained with the kittens and the fleas on them.

YOUNG jr. (F. N.) & CHRISTOPHER (W. N.). **Unusual Breeding Places of Mosquitoes in the Vicinity of Keesler Field, Mississippi.**—*Amer. J. trop. Med.* **24** no. 6 p. 379. Baltimore, Md., 1944.

Notes are given on the finding of larvae of eight species of mosquitos in unusual breeding places at Keesler Field, Mississippi, and in a neighbouring town during 1943. The Anophelines recorded are *Anopheles punctipennis*, Say, three fourth-instar larvae of which were taken in a fire barrel, *A. crucians*, Wied., three fourth-instar larvae of which were found in clear water in a rusty tin can containing leaf débris, on the edge of a small marsh, and *A. quadrimaculatus*, Say, which was fairly abundant in June and July, in spite of the lack of typical habitats, and which bred in small pools in a shallow running ditch and in shallow pools and ditches fed by water flowing from a broken main and a trickling tap.

WANAMAKER (J. F.). **An improved Method for mounting Mosquito Larvae.**—*Amer. J. trop. Med.* **24** no. 6 pp. 385–386. Baltimore, Md., 1944.

An account is given of observations leading to the development of a rapid and simple method of preparing permanent mounts of mosquito larvae that is suitable for a field laboratory. The larvae are preserved and stored in 80 per cent. alcohol and are transferred to 95 per cent. or absolute alcohol for 1–10 minutes prior to permanent mounting. They are then transferred to a clean slide containing the mounting-clearing medium, which consists of Canada balsam heated slowly to drive off almost all the xylene and thinned with creosote U.S.P. to the desired consistency. A large specimen is mounted more easily in a medium thicker than that normally used for a small thin specimen. When the larva has been arranged on the slide, a cover slip is placed over it, and the slide is ready for use after drying for 10–12 days, preferably in an incubator. Except in the case of very delicate specimens, however, the larva may be transferred directly from the 80 per cent. alcohol to the mounting mixture.

Freshly collected specimens should be killed in hot water and immediately transferred to 95 per cent. alcohol, removed to fresh alcohol after five minutes and placed on the slide after a further ten minutes. Any white liquid that may be emitted from the larva after it is placed in the mounting medium will disappear as the slide dries.

IRREVERRE (F.) & SHARPLESS (N. E.). **The Specificity of the Xanthydrol-pyridine Reaction for 2,2 bis (p-chlorophenyl) 1,1,1 trichloroethane (DDT).**—*Science* **102** no. 2647 pp. 304–305, 1 ref. Lancaster, Pa., 1945.

The following is substantially the authors' summary. The colorimetric test for DDT (2,2-bis (parachlorphenyl)-1,1,1-trichlorethane) reported by Stiff & Castillo [*R.A.E.*, B **33** 132] was extended to 17 analogues and derivatives of DDT. The absorption maxima and extinction coefficients of the coloured reactions were also obtained. The test was not specific for DDT. Of the compounds tested, the reaction was given by those having the structure $>CHCX_3$ or $>C=CX_2$, where X=Cl or Br.

YEAGER (J. F.) & MUNSON (S. C.). **Physiological Evidence of a Site of Action of DDT in an Insect.**—*Science* **102** no. 2647 pp. 305–307. Lancaster, Pa., 1945.

An account is given of experiments in which a solution of DDT was injected into specific regions of cockroaches (*Periplaneta americana*, L.) and its action compared with that of a solution of nicotine. It is concluded that nicotine affects the ganglia and DDT the nerves somewhere along their length. Contractions and tremors of a leg typical of DDT can result from the action of DDT at a site or sites common to leg and body. It is strongly indicated that the site or sites consist of that region of a nerve lying between the origin of its fibres in the ventral nerve cord and the termination of its fibres in the leg, exclusive of the origin and endings (myo-neural junctions) of the fibres. These results are consistent with the idea that DDT can provoke contractions and tremors in other appendages, or in the body, by acting at a similar site on other nerves.

PARKIN (E. A.) & GREEN (A. A.). **The Toxicity of DDT to the Housefly, *Musca domestica*, L.**—*Bull. ent. Res.* **36** pt. 2 pp. 149–162, 11 refs. London, 1945.

An account is given of the technique and results of tests of the toxicity of DDT to *Musca domestica*, L. The authors use the name *p*, *p'*-dichlordiphenyl-trichlormethyl-methane for the compound, as it is specific and yet shows the

origin of the abbreviation DDT [*cf. R.A.E.*, B **32** 197]. When atomised in a small fly-spray chamber at the rate of 2·5 ml. per 18 cu. ft., sprays containing 0·05, 0·1 and 0·5 per cent. weight in volume in kerosene of a concentrate containing 74·6 per cent. of the pure compound gave 95·8–100, 98·7–100 and 100 per cent. kill in 24 hours, respectively, and a spray containing 1 per cent. gave complete knock-down in 10 minutes and complete kill in 24 hours, while the official test insecticide (0·1 per cent. w/v total pyrethrins in refined odourless kerosene) gave only 34–39·2 per cent. kill. In a hut of 8,400 cu. ft. capacity containing 12,000 flies, 200 ml. of the 1 per cent. spray atomised in five minutes gave 80 and 99·5 per cent. knock-down in 10 and 60 minutes and 99·5 per cent. kill in 30 hours. At lower concentrations of DDT, knock-down was too slow, but this disadvantage was overcome by adding a small amount of pyrethrum extract. A mixture of 0·03 per cent. w/v total pyrethrins and 0·1 per cent. w/v DDT in kerosene is recommended. In hut tests, this mixture gave 100 per cent. kill in 24 hours, while a spray of 0·1 per cent. w/v pyrethrins gave only 85 per cent. The two sprays were similar in knock-down effect. The knock-down effectiveness of mixtures containing smaller quantities of pyrethrins and DDT was increased by incorporating 5 per cent. v/v sesame oil or 0·5 per cent. v/v isobutylundecyleneamide, which are known to increase the toxicity of pyrethrins. A solution of pyrethrum and DDT in kerosene was stored in a glass bottle in the dark for 17 months at 27·5°C. [81·5°F.] without any considerable deterioration. The toxicity of various samples of DDT to houseflies was closely related to purity, and the impurities in crude preparations apparently exerted no toxic effect. DDT acted more slowly when dissolved in industrial methylated spirit than in kerosene.

The residual toxic film produced by sprays of DDT on walls, etc., was effective for a considerable time [*cf.* **32** 200–202, etc.]. A 2·5 per cent. w/v solution in kerosene of a sample of DDT containing 77 per cent. of the pure compound was applied at 1·6 ml. per sq. ft. to the walls and ceiling of a kitchen, and control was good for two months. Counts were discontinued after this period because of the onset of colder weather. The walls of the room in which flies are bred and test chambers are kept at the laboratory were heavily treated with DDT in kerosene, and all escaping flies were still incapacitated within three hours about a year later.

The symptoms of poisoning by DDT in flies [*cf.* **32** 179–180] are compared with those caused by pyrethrum. Pyrethrins and DDT mixed in a spray apparently act independently, so that the rapid paralytic effect of the pyrethrins keeps the flies immobile until the slow lethal effect of the DDT supervenes. Sprays containing up to 2 per cent. DDT were non-irritant to man during application, but some irritation of eyes and throat was experienced with 5 per cent.

BUXTON (P. A.). **Experiments with DDT in Solutions and Emulsions against Mosquito Larvae in West Africa.**—*Bull. ent. Res.* **36** pt. 2 pp. 165–175. London, 1945.

The following is mainly based on the author's summary. Descriptions are given of small field experiments made in 1944 in the Gold Coast on the effectiveness of DDT [2,2-bis (parachlorphenyl)-1,1,1-trichlorethane] dissolved in oil alone or emulsified in water for the control of larvae of mosquitos, mainly *Anopheles funestus*, Giles, in shallow water in ditches under conditions that provided good opportunities for repetition and measurement of dose per unit area. The environment and the methods used are described. There were considerable day-to-day fluctuations in the numbers of larvae obtained by dipping, before the insecticide was applied. Kerosene and dieseline alone were not lethal to the larvae in doses up to 0·5 cc. per square yard. DDT. dissolved in emulsified or unemulsified oil, was very effective. At dosages of

0·01, 0·02, 0·1 and 0·5 cc. per square yard stagnant water, a solution of 5 per cent. pure DDT in dieseline gave kills of 100, 80–100, 100 and 100 per cent. for 1–2, 2–3, 4 and 5 days, respectively. With the highest concentration, there was partial control for several weeks. A dosage of 0·02 cc. per square yard of a 5 per cent. solution of DDT in a mixture of oil and oil-soluble emulsifier, diluted 1 : 10 in water before application, gave no kill, but 0·1 cc. gave over 80 per cent. kill for 1–2 days and 0·5 cc. gave 95–100 per cent. kill for 7–10 days. In a channel 84 yards long and 54 sq. yards in area in which the rate of flow varied from 1 to 20 feet per minute, treatment with 54 cc. of the same emulsion (0·27 gm. DDT) poured in at the top was not completely effective. This showed that the emulsion did not reach every part of the surface in spite of its great powers of spread. In other experiments in flowing water in ditches in which the rate of flow was 15–20 feet per minute at the fastest, 1–2 cc. of the dilute emulsion per square yard gave 90–100 per cent. kill of larvae and was generally completely effective for a few days. A test in water covered with algal mats and supporting an abundant growth of sedges and *Tradescantia* indicated that DDT dissolves from oil into water so as to make a larvicidal solution, at least when the water is shallow. It is difficult otherwise to account for the good kill obtained although the oil obviously did not spread. It is not known why the effect passes so quickly in stagnant waters, nor is any explanation put forward for the irregular control that followed a high dosage for as much as four weeks. Except in one experiment, in which 0·5 cc. of the emulsion per square yard killed small fish in a shallow pit, there was no evidence that predators that attack mosquito larvae were destroyed by the DDT.

THOMSON (R. C. M.). **Studies on the Breeding Places and Control of** *Anopheles gambiae* **and** *A. gambiae* **var.** *melas* **in coastal Districts of Sierra Leone.**— *Bull. ent. Res.* **36** pt. 2 pp. 185–252, 13 pls., 8 figs., 8 maps (1 fldg.), 27 refs. London, 1945.

These studies on Anophelines in the coastal areas of Sierra Leone were made between July 1942 and April 1944, mostly in and around the Freetown estuary, and dealt almost entirely with *Anopheles gambiae*, Giles, and *A. melas*, Theo. The relationship between the two forms, which are considered distinct species, is discussed with reference to the literature [*cf. R.A.E.*, B **33** 32], and their eggs, which are quite distinct, are described and figured. Examination for malaria parasites of 1,000 glands and 931 stomachs of females of *A. melas* taken in the Freetown estuary (mostly in Wellington village), showed a sporozoite rate of 4·2 per cent. for all months of the year, an oöcyst rate of 4·7 per cent., and a total infection rate of 7·8 per cent. There was no significant difference between the sporozoite rates of three-banded and four-banded females. The sporozoite rates and abundance of *A. melas* in the Freetown estuary show that it must be an important vector of malaria there. It is rare in Freetown itself and in the adjoining village of Kissy, but it is at least as important as *A. gambiae* in all other parts of the estuary, and is the dominant vector in many places, sometimes forming about 90 per cent. of Anophelines caught in houses.

The following account of the local breeding places and control of the two Anophelines is mainly based on the author's summary. Dense breeding of *A. melas* is confined to brackish water and areas flooded by the high spring tides. Breeding in fresh water, outside the tidal zone, is negligible. This tidal zone, between low tide mark and high spring tide mark, is characterised by great stretches of mangrove, of which there are two main types in West Africa. By far the commoner is *Rhizophora racemosa*, which may occur in all parts of the tidal zone. It has aerial stilt roots and viviparous seeds and varies much in size. Most of the *Rhizophora* zone is flooded twice daily by the mean high tides. The other mangrove is *Avicennia nitida*; it has no stilt roots, but the

ground round it is covered with asparagus-like stalks growing up from the shallow root system. The trees are well spaced and fairly uniform in size and usually grow on very flat tidal areas flooded only by the high spring tides, often in characteristic pure stands or "orchards," varying from 2–3 to over 50 acres in extent. Dense breeding of *A. melas* is mostly confined to these, while little or no breeding occurs among *Rhizophora* or isolated trees of *Avicennia* or even in the narrow fringe that sometimes occurs along the upper edge of the mangrove zone or on the grassy shore. The *Avicennia* orchards are important because they are on badly drained peaty soil, flooded frequently during the wettest months by rain-water and every 12 hours for four or five days in each fortnight (or in each month at certain times of the year) by the high spring tides in the dry weather. Breeding continues in the open spaces when the mangroves are removed and among the salt-marsh plants that soon appear, and it may extend a few yards into *Rhizophora* and occur on the flat grassy shore beyond the mangrove zone. The eggs may lie dormant in the damp mud for at least a week, and hatch when the area is re-flooded, eventually giving rise to large numbers of adults of the same age. The influence of tides on oviposition and periodicity of breeding is discussed. Salinity varying from 0·1 to 100 per cent. sea water apparently did not influence oviposition.

From high ground or from the air, the *Avicennia* orchards can usually be distinguished in the dry weather by the very light colour of the foliage, compared with the slightly darker green of the medium-sized *Rhizophora* and the very dark green of the tall *Rhizophora*. They also show up clearly in good vertical aerial photographs, which are now being used more and more extensively to locate and map possible breeding grounds. Breeding in the orchards is greatly influenced by the tides, and the best time to visit an apparently suitable place is towards the end of the high spring-tide period, either early in the morning before the high tide has flooded the area or 5–6 hours after high tide. When the falling spring tides no longer flood the *Avicennia*, full-grown larvae are particularly abundant in the pools left behind, although the same pools may contain no larvae a few days later. Except in the wettest months, the orchards dry up during the neap tides, and at certain periods may be quite dry for over three weeks at a time. Unless the time is carefully chosen, therefore, larvae may not be found even in the orchards that support the heaviest breeding. The *Avicennia* orchards form only a small proportion of the great mangrove belt in the Freetown estuary, and the aim of measures against *Anopheles melas* is to effect control by building bunds or dikes 3–4 feet high round the orchards to keep out the spring tides, draining the reclaimed area and allowing the rain and seepage water to escape at low tide through a tidal gate or hand-operated sluice. There are five main orchards to be reclaimed in this way in the estuary.

The breeding places of *A. gambiae* were studied in the area of the estuary and in the Sierra Leone Protectorate. The rainy season extends from about the end of May till the end of October and the dry season from about mid-November to mid-May. July, August and September are the months of heavy rainfall, with averages of over 30 inches each, and rainfall is very scanty in December–March. In the months of heavy rainfall in the Freetown-Kissy region, many suitable-looking sunlit pools contain no larvae of *A. gambiae*. The few pools or puddles in which larvae are found usually contain large numbers, and breeding may continue in them for several weeks. Only a very small proportion of old pits and small holes in bare laterite at Kissy contain *A. gambiae*, but dense breeding may occur in recently dug, rain-filled holes in laterite in the rainy season. Shallow, rain-filled pools or groups of pools and footprints or wheel ruts on soil on level ground are the chief breeding places. These tend to dry up after one or two days without rain. Eggs can survive for at least six days in the damp mud, young larvae for two days and full-grown larvae for several hours; also adults can emerge from pupae in it. Careful

search to find the few pools or puddles that produce all the larvae must form the basis of control of *A. gambiae*. This restriction of dense breeding to an odd pool or group of pools was a feature in every place investigated in the rains, both in the Colony and in the Protectorate.

In the dry weather, conditions in Freetown are different from those in the rest of the Colony. In Freetown, the lower stretches of the two main perennial streams have foul, polluted water and may support dense breeding in several places. They must be controlled by routine anti-larval measures, but are much less important than the rainy-season breeding places. Outside Freetown, most perennial streams are of minor importance. In the few in which breeding takes place, it is dense only in comparatively few small pools, and never diffused along the whole of the stream edge. More larvae are found in sweet-potato plots. The importance of grassy-edged streams in the Protectorate is negligible. Breeding may occur throughout the rice-growing season at all stages of cultivation in rice plots reclaimed from tidal swamps by bunding. In the great swamp rice lands of the Scarcies, dense breeding in the rains is restricted to a very limited part of the zone at the edge of the swamp. Within these small breeding grounds, larvae of *A. gambiae* may be found in every puddle. The breeding grounds may be in rice fields, rice nurseries, sweet-potato plots or fallow grassy plots at the edge of the swamp and are related more to the type of ground than to the type of crop or stage of cultivation. Breeding places are more extensive in the dry weather in pools left on the rice flats by the tidal river, and in relict pools formed by the drying-up of inland swamps in which there were no larvae during the rains.

Experiments on the factors influencing the selection of breeding places by females of *A. gambiae* show that dense shade alone will not prevent oviposition in a regular breeding place. Females will also lay eggs on water covered by a film or scum formed by iron bacteria, although the eggs do not hatch or the young larvae develop till the film is broken up by rain. Mechanical obstruction is a more important deterrent than shade. Increasing the salt content of a regular breeding place will not deter females from laying eggs until salinity reaches 38 per cent. sea water. The female is indifferent to salinity up to 30 per cent. sea water.

A. nili, Theo., was found to be a vector of malaria in the Orugu valley of the Sierra Leone Colony for at least six months of the year. In the driest months it was about ten times as numerous as *A. gambiae* in houses there. The breeding places in the Orugu River, where the larvae are abundant, are described.

PEMBERTON (C. E.). **Insects carried in transpacific Airplanes. A Review of Quarantine Work prior to December 7, 1941.**—*Hawaii. Plant. Rec.* **48** no. 3 pp. 183–186. Honolulu, 1944.

From March 1936 to December 1941, all aircraft stopping at Honolulu on their way across the Pacific were inspected for insects. They were also sprayed with pyrethrum extract shortly before landing at each port and before leaving it. Quarantine stations, where aircraft were inspected, were established on Canton and Midway Islands during the period, in the course of which 301 aircraft arrived in Hawaii from Hongkong or Manila via Midway Island or from New Zealand via Canton Island, and 10,081 insects, of which 2,067 were alive, were removed at Canton, Midway or Honolulu and identified. Only 22 living insects not known in Hawaii were found in these aircraft at Honolulu. Among the insects taken at the three stations were four living individuals of *Culex fatigans*, Wied. (*quinquefasciatus*, auct.) and 207 dead mosquitos, including *Anopheles litoralis*, King, *Aëdes vexans*, Mg., *A. vigilax*, Skuse, and *C. sitiens*, Wied. During the same period, 1,367 insects, of which 137 were alive, were removed from the 321 aircraft arriving at Honolulu from California and identified. They included 88 mosquitos among which were

one living female of *Anopheles pseudopunctipennis*, Theo. [*cf. R.A.E.*, B **31** 247], five living individuals of *C. pipiens*, L., and one of *Culiseta* (*Theobaldia*) *incidens*, Thoms. *Culex tarsalis*, Coq., was taken dead.

Osorno Mesa (E.). **Organización de una colonia de *Haemagogus equinus* Theobald.**—*Caldasia* [**3**] no. 11 pp. 39–45, 3 figs. Bogotá, 1944.

Details are given of the methods used for maintaining a colony of *Haemagogus equinus*, Theo., that has been established in the laboratory at Bogotá, Colombia, in order that material for experiments on the transmission of yellow fever by this mosquito [*cf. R.A.E.*, B **32** 230; **33** 112] may be available throughout the year. It was started with eggs laid in test tubes by females taken in nature in August 1942; the tubes were covered with gauze on which was a pad of cotton-wool moistened with sugar solution, and the mosquitos were allowed to feed through the gauze on mice at intervals. Other colonies have been established by collecting larvae from natural breeding places, but in this case care must be taken to segregate them from their many natural enemies, which include larvae of *Megarhinus* and *Trichoprosopon* (*Goeldia*) and the young of the frog, *Dendrobates lugubris*.

The eggs are kept under semi-dry conditions for a fortnight and then submerged in spring water (pH 8·2). The larvae hatch in periods that range from a few hours to three days and are transferred three days later to large receptacles, together with a little oats, dried leaves macerated in water taken from tree-holes and Crustacea from the same source, a culture of which is now maintained in the laboratory. Leaves of a species of *Ligustrum* proved suitable in experiments. The pupae are transferred to tubes, and, a few hours after emergence, the adults are released into cages containing corrugated paper, banana, and cotton-wool and filter paper moistened with sugar solution in petri dishes, and kept at about 25–27°C. [77–80·6°F.]. Small cages were used at first, but it was later found that somewhat larger ones, measuring $36 \times 25 \times 27$ cm. or $34\frac{1}{2} \times 34\frac{1}{2} \times 27$ cm., were preferable, as it was easier to arrange for the blood-meals. The cages are shaded by curtains and are exposed to the direct rays of the sun or to artificial light for two hours each morning to encourage pairing. Continued feeding on mice has recently resulted in some decrease in the duration of life of the females, and a blood-meal on man has therefore been substituted. Ten generations have so far been reared, and data for the first eight of them are shown in a table.

In attempts to rear other species of *Haemagogus* in captivity, some success has been obtained with *H. lucifer*, H., D. & K., and an unidentified species from Chocó, but none with *H. capricorni*, Lutz.

Hecht (O.) & Anduze (P. J.). **Contribución al conocimiento de la fauna culicidiana de la parte norte de la Guayana venezolana.** [Contribution to the Knowledge of the Mosquito Fauna of the northern Part of Venezuelan Guiana.]—*Bol. Ent. venezolana* **3** no. 3 pp. 105–118, 16 refs. Caracas, 1944. (With a Summary in English.)

A list is given of the 42 species of mosquitos collected near Upata in the State of Bolivar, Venezuela, during three visits made between April 1943 and June 1944, in the course of a survey undertaken in connection with studies of jungle yellow fever in that region. Notes on the circumstances in which larvae or adults were taken are given in each case. Most are jungle species. A table published by J. S. Simmons in 1939, showing mosquitos other than *Aëdes aegypti*, L., that have been found naturally infected with the virus of yellow fever in the western hemisphere or have been proved capable of harbouring the virus or transmitting it by bite is also given, species found in the present survey or previously known to occur in Venezuela being indicated. Those

that have been found infected in nature include *Aëdes leucocelaenus*, Dyar & Shannon [*cf. R.A.E.*, B **32** 184], which is recorded from Venezuela for the first time.

The Anophelines found were *Anopheles argyritarsis*, R.-D., *A. oswaldoi*, Peryassú, *A. pessôai*, Galvão & Lane, and *A. rangeli*, Gabaldón, Cova-García & López.

Davis (D. E.). **A Comparison of Mosquitoes captured with an avian Bait at different vegetatiónal Levels.**—*Rev. Ent.* **15** fasc. 1–2 pp. 209–215, 1 ref. Rio de Janeiro, 1944.

In connection with studies of the ecology of animals related to jungle yellow fever in Brazil [*cf. R.A.E.*, B **27** 121], one-compartment mosquito traps of the Shannon type [*cf.* **27** 193] containing various birds as bait were exposed at three levels in the forest at two points in the coastal hills of Rio de Janeiro in 1942–43. The species and numbers of the mosquitos taken are shown in a table, and notes are given on the height preferences of most of the genera represented in the catches. Species of *Aëdes* were consistently taken at ground level, though they were also caught in the higher traps, while *Haemagogus capricorni*, Lutz, which was not numerous, was taken only at the two higher levels [*cf.* **32** 184–185].

Unti (O.). **Informes sôbre cloretos de alguns criadouros de culicídeos.** [Report on the Chloride-content of some Mosquito Breeding Places.]—*Arq. Hig. Saúde públ.* **5** no. 9 pp. 115–124, 9 refs. São Paulo, 1940. (With Summaries in English, French and Italian.)

References in the literature to the action of chlorides on mosquito larvae are reviewed, and the results are given of preliminary observations on the salinity of water in breeding places at São Vicente in São Paulo, Brazil. Larvae of various mosquitos, including species of *Anopheles* of the *Nyssorhynchus* and *Arribalzagia* groups, were found in water with chloride contents ranging from 0·010 to 7·5002 parts Cl per mille, and in the few cases in which pH was determined, an almost neutral reaction with a slight tendency to acidity. Some apparently suitable breeding places, however, contained no larvae, though the water had chloride contents within this range, a similar pH, and occasionally a connection with an actual breeding place. The concentrations of chlorides in a few samples of water considered unsuitable for mosquito breeding are also given.

[**Papers on Mosquito Control.**]—*Mosq. News* **4** no. 4 pp. 103–158, 9 figs. New Brunswick, N. J., 1944.

These papers include **References to Literature of Interest to Mosquito Control Workers,** by H. H. Stage (pp. 153–158), and **Mosquito Culture Technique,** by H. L. Trembley (pp. 103–119, 4 figs., 3 pp. refs.). In the latter, the author discusses the objects of small-scale rearing of mosquitos and describes the equipment required for it and the procedure to follow in rearing *Anopheles quadrimaculatus*, Say, *Aëdes aegypti*, L., and *Culex pipiens*, L., and *C. fatigans*, Wied. (*quinquefasciatus*, auct.), the only species in the United States for which definite steps can be recommended for continuous rearing in small cages. Notes are given on the water and food requirements of mosquitos, and the effects of variations in temperature, humidity and light. The experience of other workers in the large-scale rearing of mosquitos is discussed, and a selected bibliography is appended with sections on large-scale rearing technique, nutrition, temperature, humidity and light, and miscellaneous matters.

The section entitled Reviews and Abstracts includes a note (pp. 151–152) on a recently patented insect repellent composition (U.S. Patent 2,356,801, issued August 29, 1944). It consists of 60 per cent. dimethyl phthalate, 20 per cent. Rutgers 612 (2-ethyl-1,3-hexanediol) and 20 per cent. Indalone (n-butyl mesityl oxide oxalate). The average repellent times in minutes of this mixture and of each of the three components in the order named were determined as 257, 206, 78 and 30 for *Anopheles quadrimaculatus*, Say, 321, 234, 363 and 160 for *Aëdes aegypti*, L., and 189, 47, 101 and 171 for *Stomoxys calcitrans*, L., all in the laboratory, and 212, 153, 276 and 164 for *A. taeniorhynchus*, Wied., in the field. The composition may cause a slight, temporary stinging sensation when applied undiluted to the more sensitive areas of the skin, but it has been shown to be toxicologically safe for repeated application.

Tate (H. D.) & Gates (D. B.). **The Mosquitoes of Nebraska.**—*Res. Bull. Neb. agric. Exp. Sta.* no. 133, 27 pp., 1 fig., 1 fldg. table, 37 refs. Lincoln, Neb., 1944.

The following is based almost entirely on the authors' summary. Mosquitos, particularly those breeding in flood water, regularly reach high levels of population in irrigated regions of Nebraska, often interfering with agricultural operations, and they occur in troublesome numbers in non-irrigated areas during rainy periods. In irrigated sections, they breed almost entirely in drainage and seepage water. Some 250,000 mosquitos were collected in light-traps in 19 different localities of the State during 1942 and 1943 and identified, and some material, including immature stages, was collected by hand. In all, 33 species, representing 8 genera, were obtained, 15 species being new records for the State. Brief biological and ecological notes are given on most of them, with tables showing the numbers of those taken in light-traps and collection records for the various trap sites.

Of the total light-trap catch, *Aëdes vexans*, Mg., comprised 52 per cent., *Culex tarsalis*, Coq., 23 per cent., *Culiseta inornata*, Will., 7·1 per cent., *A. dorsalis*, Mg., 6·7 per cent., and *A. nigromaculis*, Ludl., 6·6 per cent. Virus encephalitis is common in man and horses in the area, and all five of these mosquitos are experimental vectors of western equine encephalomyelitis, while *Culex tarsalis*, *Culiseta inornata* and *A. nigromaculis* can also transmit the St. Louis virus. Four species of *Anopheles* were collected. *A. walkeri*, Theo., and *A. punctipennis*, Say, were the most common. *A. quadrimaculatus*, Say, did not appear to be sufficiently abundant over a long enough period to be of more than local and temporary importance in disseminating malaria. *A. maculipennis occidentalis*, D. & K., was taken in small numbers by hand in the north-west.

Entomology and economic Zoology.—*54th Rep. Ariz. agric. Exp. Sta. 1942–43* pp. 51–53. Tucson, Ariz., 1944.

Triatoma rubida uhleri, Neiva, *T. protracta*, Uhl., and *T. longipes*, Barber, which always attack sleeping persons to some extent in early summer in Arizona, were particularly annoying in May and June 1943. As the first two breed only in the nests of wood rats [*Neotoma*] and are seldom found far from them, only dwellers in rural areas are attacked. Houses are not infested if all wood rats within a radius of 200 yards are destroyed by trapping. The Cimicid, *Haematosiphon inodorus*, Dugès, also caused great discomfort to man, particularly in April, May and June. *Rhipicephalus sanguineus*, Latr., which is an introduced tick in Arizona, was rather plentiful in houses during the summer of 1942; its numbers are increasing as dogs become more numerous, but it seldom attacks man.

[Khatin (M. G.).] **Хатин (М. Г.). Sodium Thiosulphate and Sodium Bisulphate for the Treatment of Mange.** [*In Russian.*]—*Veterinariya* **21** no. 5–6 pp. 33–35. Moscow, 1944.

Nascent sulphur is very effective against the mange mites of domestic animals, but the method of obtaining it from the reaction of sodium thiosulphate and hydrochloric acid [*cf. R.A.E.*, B **29** 182], which is that so far employed in Russia, is inconvenient. It can also be evolved by the reaction of sodium thiosulphate and sodium bisulphate, which releases sulphur and sulphur dioxide. The thiosulphate is obtainable in the form of a powder, and the bisulphate in crystals that are easily ground into powder, and both can be applied to the animals dry, in water solution, in soap and water or incorporated into ointments. In preliminary laboratory tests, treatment with these substances killed lice and mange mites, and had no detrimental effect on horses or laboratory animals. The reaction of the two components continued for about a fortnight in a mixture of water solutions containing 30 per cent. thiosulphate and 40 per cent. bisulphate, for up to a week in mixtures with soap and water and for up to 5 days in dry mixtures. The treatment was successfully applied in unheated stables or outdoors to horses heavily infested with mange mites. After the animals had been cleaned and brushed, the hair was clipped from the infested areas and they were wetted with water. Finely powdered sodium bisulphate was then rubbed in with a moist brush, followed by a similar application of sodium thiosulphate. In some cases, two applications were required for complete control.

[Voronov (D. L.).] **Воронов (Д. Л.). Local Treatment of Mange in Horses and Cattle.** [*In Russian.*]—*Veterinariya* **21** no. 7 pp. 10–13. Moscow, 1944.

The author considers that mange in horses and cattle can be controlled as effectively by treatment of the affected areas as by treatment of the whole body surface, with a considerable saving of materials and time. As the feeding and development of species of *Psoroptes* and *Sarcoptes* are closely connected with pathological changes in the skin, and the mites concentrate where the skin is subject to rubbing and is irritated and inflamed, local treatment, in addition to killing the mites, should counteract the changes in the skin and render it unsuitable for infestation.

Substances that were found effective against mange in horses and cattle were lime-sulphur, prepared by boiling 5 lb. quick-lime and 10 lb. sulphur in 12 gals. water for 1–1½ hours, and wood tar. The latter is used at concentrations of 4–15 per cent., diluted in a vegetable oil or emulsified with ash (1 : 5) or soap (4 : 5) in water. These preparations should be well rubbed into the affected areas, and applied five times at successive intervals of about 2, 3, 4 and 6 days; details are given of the successful treatment of a horse that had been severely infested with *Psoroptes equi*, Hering, for two months by four local applications of a 4 per cent. emulsion of tar and soap, less than an ounce of tar being used for the whole treatment.

[Dobrovol'skiĭ (B. V.) & Tikhomirov (F. K.).] **Добровольский (Б. В.) и Тихомиров (Ф. К.). Ayu-chach.** [*In Russian.*]—*Veterinariya* **21** no. 7 p. 33. Moscow, 1944.

In investigations in 1943 in the district of Osh (western Kirghizia) on treatments against mange in horses and other domestic animals, an infusion was made by boiling one part by weight of the roots of a wild perennial plant of the genus *Prangos* (known locally as ayu-chach) in ten parts water for 1½–2 hours. When the affected areas on horses infested with *Psoroptes equi*, Hering, and *Sarcoptes equi*, Gerlach, were first rubbed with the stringy remains of the boiled roots and then washed with the infusion, the mites were eliminated. Control of mange [*P. ovis*, Hering] on sheep was obtained only if they were

first washed in a 10 per cent. infusion of plant ash, which dissolved the crusts that covered the affected areas, and then dipped twice, with an interval of six days, in a 5 per cent. *Prangos* infusion.

[Cherkasskiĭ (E. S.).] **Черкасский (Е. С.). Wood Creolin.** [*In Russian.*] —*Veterinariya* **21** no. 5–6 pp. 22–33, 3 figs. Moscow, 1944.

[Tzitzin (N. V.) & Cherkasskiĭ (E. S.).] **Цицин (Н. В.) и Черкасский (Е. С.). The Classification of the Wood-tar Creolins, their mass Application against Mange on Animals and their Effect on the Quality of the Wool.** [*In Russian.*]—*Veterinariya* **22** no. 4–5 pp. 23–28, 1 fig., 1 ref. Moscow, 1945.

Accounts are given in these papers of preliminary experiments in eastern Siberia in 1943 in which creolins, formed by adding emulsifiers to various tar oils obtained from the distillation of wood, were tested for the control of mange mites, chiefly *Psoroptes ovis*, Hering, on sheep. In the first of them, methods of obtaining wood-tar oils and preparing creolins are described, the characteristics of several products of each group are shown in tables and discussed, and it is stated that the best emulsifiers for the oils were found to be common soap (containing not more than 30–36 per cent. moisture) and saponified colophony or crude resin. In the second, it is pointed out that wood tar of any origin is suitable for the preparations of creolins, and a system of classifying the latter is described and illustrated on a chart.

In laboratory tests described in the first paper, batches of 30–45 examples of *P. ovis* enclosed in muslin bags were dipped for two minutes in six creolins at concentrations of 0·25–2 per cent. and a temperature of 37–40°C. [98·6–104°F.]. The bags were then drained, left to dry at 37 or 17–18°C. [62·6–64·4°F.] and examined at intervals that ranged from 20 minutes to 24 hours. All six creolins gave complete mortality in 20 minutes at 2 per cent., and the most effective were those prepared from hardwoods, light-medium fractions being more effective than others. The effectiveness appeared to be due to the neutral oils. Eggs were not killed, but hatching was delayed for a day or two. Following experiments in which creolins were shown to be harmless to sheep, horses and cattle at concentrations of up to 3 per cent., and also to wool, large-scale tests were carried out on farms in 1943, chiefly with sheep infested with *P. ovis* and horses infested with *P. equi*, Hering. The sheep were first scrubbed with soap, which was washed off with warm water on the following day, and then dipped a day later for two minutes in 2·5 per cent. creolin at a temperature of 40°C. Dipping was repeated six days later. The horses were washed three times at intervals of three days with 2·5 per cent. creolin at 37–40°C., the liquid being rubbed or brushed well in. All the treated animals were freed from the mites and had not become reinfested six months later, when the observations were concluded.

In further experiments in 1944, described in the second paper, several hundred thousand sheep were freed from *P. ovis* by first washing them in 5 per cent. creolin and then dipping them twice in 2 per cent. creolin. It was subsequently found that if the dip was heated to 43–45°C. [109·4–113°F.], a single application was effective, as it killed the eggs as well as the mites, without harming the sheep. Horses, cattle and pigs were freed from unspecified forms of mange by dipping them three times in 2·5 per cent. creolin.

[Ishukov (G. Kh.) & Ishukova (F. A.).] **Ишуков (Г. Х.) и Ишукова (Ф. А.). The Rôle of the Pasture Tick, *Dermacentor marginatus*, in Epizootics of Infectious Encephalomyelitis of Horses.** [*In Russian.*]—*Veterinariya* **22** no. 4–5 pp. 17–21. Moscow, 1945.

The occurrence of encephalomyelitis in horses in the Republic of Bashkiriya (in the eastern part of European Russia) has been recognised for several years,

but attempts by various workers to ascertain its mode of transmission have been unsuccessful. It occurs chiefly in low-lying damp or swampy places covered with shrubby vegetation in which blood-sucking Diptera are abundant, but the virus has never been found in mosquitos or flies collected in the field. It was thought to have an Arthropod vector, however, as infection begins in summer, reaches its peak in September and almost completely dies out with the onset of cold weather. Since outbreaks have coincided with years of mass abundance of pasture ticks, of which *Dermacentor marginatus*, Sulz., is the commonest, the ability of this species to acquire and harbour the virus was studied in 1943. Details of the experiments are given in tables ; the presence of the virus in the ticks was proved by injecting suspensions of them into healthy rabbits, and it was shown in this way that the ticks could acquire the virus by feeding on artificially infected rabbits, that it persisted in them for a considerable time, and that it was present in ticks collected from infected horses or from localities in which the disease occurred after they had been kept in 50 per cent. glycerine for 45–72 days.

[Nazarov (G. S.), Ronzhina (G. I.) & Gur'yanova (M. P.).] **Назаров (Г. С.), Ронжина (Г. И.) и Гурьянова (М. П.). The Application of Chlorpicrin-Creolin Emulsion for the Control of Mange in Sheep.** [*In Russian.*] —*Veterinariya* **22** no. 6 pp. 17–19. Moscow, 1945.

Good control of *Psoroptes ovis*, Hering, was obtained in two areas in the south-east of European Russia in the summer of 1943 by dipping some 49,000 sheep in dilute emulsions of chlorpicrin. The stock emulsion consisted of 2 parts liquid soap, 1 part chlorpicrin and 2 parts water, and the concentrations of chlorpicrin in the dips were 0·12 and 0·075 per cent., respectively. The animals were dipped twice. In laboratory tests, examples of *P. ovis* immersed in emulsions of chlorpicrin at concentrations of 0·1 and 0·05 per cent. died in 1½–2 and 15 minutes. In further tests on some 3,500 sheep carried out in view of the shortage of soap, creolin was substituted as the emulsifier, and a stock emulsion was prepared by mixing 2 parts creolin with one part chlorpicrin and slowly adding 4–8 parts water. In the only case in which the concentration of chlorpicrin in the diluted dip is given, it was 0·1 per cent. The animals were dipped twice at an interval of about a week. No mites were found in skin scrapings from the sheep after the second dip, and the condition of the sheep was good after treatment and a month later.

Chlorpicrin emulsified with soap or with creoline makes cheaper dip than lime-suphur, tobacco, or creolin alone. Only 5 gals. chlorpicrin and 10 gals. creolin are required for two treatments of 3,000 sheep.

[Aleksandrov (N. A.).] **Александров (Н. А.). Rhinoestrosis of Horses.** [*In Russian.*]—*Veterinariya* **22** no. 6 pp. 19–20. Moscow, 1945.

Infestation of the nasal tracts of horses by larvae of *Rhinoestrus purpureus*, Brauer, is comparatively frequent in the Russian Union, though not always correctly diagnosed. The mature larvae and the symptoms of infestation are described and brief notes are given on the appearance and habits of the adult fly [*cf. R.A.E.*, B **3** 217]. In one of two instances of infestation observed by the author, 14 mature active larvae dropped from the nose of the horse ; in the other, which proved fatal, larvae in various instars were found attached in groups to the upper part of the pharynx and especially in the nasal sinuses. When applied directly to larvae freely crawling about, benzine gave complete mortality, ether stupefied the larvae but they eventually revived, and turpentine and aqueous dilutions of formaldehyde and creolin hardly affected them. It is considered, therefore, that benzine should be tested in practice, either pure or mixed with oil, by applying it to the mucous membranes of the noses of infested horses.

[Akchurin (B. S.).] **Акчурин (Б. С.). Rhinoestrosis of Horses in the Bashkir ASSR.** [*In Russian.*]—*Veterinariya* **22** no. 6 pp. 21–22. Moscow, 1945.

An outbreak of *Rhinoestrus purpureus*, Brauer, occurred in a mountain-forest region of the Republic of Bashkiriya from May to the end of August 1943, during which period the nasal passages of 11·2 per cent. of the horses on 27 collective farms were infested and over 82 per cent. of the affected animals died. The infestation reached its peak in June, and working animals in rather poor condition were those chiefly affected. The infestation is not apparent at first, and though the symptoms become acute in the later stages, they are not easy to diagnose. If the horse dies, however, the larvae can be found in the nasal and throat regions or at the base of the tongue ; in some instances, over 200 were found firmly attached in the nasal and pharyngeal cavities.

In laboratory tests, mature larvae of *R. purpureus* survived for days in diluted creolin or 20 per cent. salt solution, 30 hours in undiluted creolin, 24 hours in a 20 per cent. emulsion of carbon tetrachloride, and 15–20 minutes in undiluted carbon tetrachloride, but all these liquids caused larvae on pieces of horse tissue to detach themselves. All horses on the infested farms were therefore subjected daily for 6–7 weeks from 7th July to syringing of the nasal cavities, 20 per cent. salt solution and 10 per cent. creolin being used on alternate days. Each treatment was followed by smearing with a mixture of tar and turpentine, which repelled the flies and killed any newly deposited larvae. Horses from which larvae were washed out were kept from work for 4–5 days and made to inhale the vapours from a mixture of tar and turpentine. The percentage of infestation following this treatment dropped to 2·2. Syringing when the horses already showed acute symptoms of infestation was useless.

[Sinev (A.), Saltuikov (F.) & Gol'mov (V.).] **Синев (А.), Салтыков (Ф.) и Гольмов (В.). Kimaï—a popular Remedy for the Mange of Sheep.** [*In Russian.*]—*Veterinariya* **22** no. 6 pp. 31–33, 1 fig. Moscow, 1945.

[Sultanov (M. A.).] **Султанов (М. А.). The simplest Method of obtaining Kimaï.** [*In Russian.*]—*T.c.* p. 34, 1 fig.

An oil distilled from sheep dung, known in Kazakhstan as kimaï, has long been used there for the treatment of mange in sheep and was successfully employed for this purpose in 1944 on several farms in the region of Stavropol. It is harmless to sheep and contains up to 30 per cent. phenols and also apparently some pyridin. Methods of distilling it under farm conditions are described in detail in these papers. The oil obtained from dry distillation of the dung is saponified with caustic soda or caustic potash, and the animals are dipped in a 10 per cent. concentration, which in laboratory tests killed unspecified mange mites in 5–15 minutes.

Adamson (J. S.). **Dipping of Cattle.**—*Rhod. agric. J.* **41** no. 6 pp. 385–392. Salisbury, S. Rhod., 1944.

The importance in Southern Rhodesia of dipping cattle to prevent the spread of tick-borne diseases, particularly African coast fever [caused by *Theileria parva*], is stressed, and attention is also drawn to the improvement effected in an animal's general condition by freeing it from ticks in this way. Satisfactory control of ticks on the animal and on the veldt can be obtained by weekly dipping in a sodium-arsenite solution containing 0·16 per cent. arsenious oxide. No satisfactory substitute for arsenic has been found. Notes are given on the preparation of the dip, the maintenance of the strength of the solution, precautions to be taken in connection with dipping, and the treatment

of arsenical poisoning and dip scalding, and the properties of a good dipping tank are described. The nature of the action of the arsenical fluid on the ticks, the advantage of a dip containing an emulsifier and the addition of tobacco extract or waste to the dip to increase its efficiency [*cf. R.A.E.*, B **32** 124] are also briefly dealt with. When the ears, udders and tails of cattle are infested, it is necessary to dress the areas by hand with greases, formulae for which are given. It is recommended that dogs, horses, sheep and goats be dipped occasionally.

CHORLEY (J. K.). **Tsetse Fly Operations. Short Survey of the Operations by Districts for the Year ending December, 1943.**—*Rhod. agric. J.* **41** no. 6 pp. 412–419; also as *Bull. Minist. Agric.* [*S. Rhod.*] no. 1283, 8 pp. Salisbury, S. Rhod., 1944.

There was little improvement in the position as regards trypanosomiasis of cattle in the Chipinga area of the Melsetter District, on the eastern border of Southern Rhodesia, in 1943 [*cf. R.A.E.*, B **32** 23]. The total number of tsetse-flies caught on the Rhodesian side of the border was 20, comprising 11 males and five females of *Glossina pallidipes*, Aust., and three males and one female of *G. brevipalpis*, Newst., while 15 males and 13 females of the former and one male and two females of the latter were taken in the clearing on the Portuguese side. Extensive additions were made to the main border clearing. Patrols carried out in Portuguese East Africa and on the border farms indicated that *G. morsitans*, Westw., has not spread much further up the Busi Valley, though individuals were caught about one mile from the border. A light infestation of this species was found in the lower Sabi Valley inside Southern Rhodesia during the year, and trypanosomiasis caused heavy mortality among cattle in the neighbourhood. It is not anticipated that the Sabi and Lundi Rivers will act as effective barriers to the westward spread of the fly as they carry little water in the dry season. The Portuguese Government has declared a large area in Portuguese East Africa along the border east of the Melsetter district an open area for the destruction of all classes of game. This may have highly beneficial results in the control of *G. morsitans* if intensive shooting operations can be organised. The presence of tsetse on the border in the Vila Gouveia area of Portuguese East Africa opposite Inyanga has been notified.

Satisfactory progress was made in the northern areas infested by *G. morsitans*, fly densities over the whole area covered by the operations showing a progressive reduction. No cases of animal trypanosomiasis were recorded from these areas. *G. pallidipes* was found to occur some distance south of its previously known limits in the Sebungwe district [*cf.* **32** 24]. The north-eastern boundary of the area remains heavily infested. Eight more cases of sleeping sickness were recorded from the Urungwe district, three foci of the disease being now recognised. The situation in individual districts is briefly reviewed, and incidental aspects of tsetse control are discussed.

DE MEILLON (B.) & LAVOIPIERRE (M.). **South African "Creeping Eruption."** —*S. Afr. med. J.* 1944 pp. 115–116, 1 fig., 3 refs. Cape Town, 1944.

In 1939, Murray reported that he had found South African "creeping eruption" to be caused by a mite [*R.A.E.*, B **28** 50]. An account is here given of experiments made in 1943–44 in which creeping eruption was induced in a human volunteer by placing on the forearm larvae bred from hookworm eggs obtained in the faeces of a dog from the south coast of Natal, where creeping eruption occurs. From an analysis of Murray's observations and an examination of the mites that he found, it is concluded that it is extremely improbable that these mites, which consisted of adult Tyroglyphids of two genera and an adult Tarsonemid, could have caused the lesions described and

figured by him. None has been recorded as forming burrows. It is highly probable that they were contaminants or secondary invaders.

SALT (R. W.). **The Effects of subzero Temperatures on *Hypoderma lineatum* DeVill.**—*Sci. Agric.* **25** no. 3 pp. 156–160, 1 fig., 2 refs. Ottawa, 1944.

Small-scale experiments made in Canada on the effect of low temperatures on larvae of *Hypoderma lineatum*, Vill., that have dropped from cattle showed that contact moisture had no effect on the undercooling of the larvae, the mean undercooling point for both dry and wet larvae being about −23°C. [−9·4°F.]. All larvae died on being frozen, even if removed from the freezing chamber a few seconds after the rebound started. The lethal temperature range is therefore the undercooling range. Corresponding experiments with puparia gave similar results. Again, contact moisture had no effect and freezing was fatal. The mean undercooling point for larvae and pupae in puparia was about the same as for exposed larvae, but the rebound took place at a somewhat higher temperature among individuals in the act of pupating than among others.

A series of temperature readings made between 15th February and 31st March 1944 with apparatus specially adapted for penetrating soil, manure and straw, when these are not packed too hard, showed that there is little chance of early-dropped larvae being frozen and killed in southern Alberta. Early spraying of cattle may, therefore, be necessary. Preliminary observations indicated, however, that most, if not all, of the earliest dropped larvae are immature. It has often been noticed that very early in the season (February and early March in southern Alberta), white larvae, apparently full-grown, are found stuck to the hair of infested stock or protruding partly from the emergence hole, encased in a considerable amount of pus. Usually these immature forms are dead when found, and living ones taken to the laboratory died within a day or two. Four others were frozen soon after removal from the backs of the animals and their undercooling points were found to vary from −5·7 to −14·6°C. [21·74° to 5·72°F.]. Failure to observe mature larvae emerging before the cold weather is past may be due to chance, however, as they are rarely seen emerging at any time.

PAPERS NOTICED BY TITLE ONLY.

TAYLOR (F. H.). **The intermediary Hosts of Malaria in the Netherlands East Indies (with Notes on the Distribution of Malaria by R. E. Murray).**—*Serv. Publ.* (*Sch. publ. Hlth trop. Med.*) *Dep. Hlth Aust.* no. 5 (2nd edn.), 100 pp., 16 maps (1 fldg.), 25 figs., 29 refs. Sydney, 1944. [*Cf. R.A.E.*, B **32** 211.]

LANE (J.). **A tribo Megarhinini no Brasil Meridional.** [The MEGARHININI of southern Brazil, with keys and descriptions.]—*Rev. Ent.* **15** fasc. 1–2 pp. 172–190, 11 figs., 4 refs. Rio de Janeiro, 1944.

CERQUEIRA (N. L.) & LANE (J.). **Sôbre algumas espécies de *Culex* (*Carrollia*) (Diptera, Culicidae).** [Some Species of *Culex* (*Carrollia*) from Brazil, including *C.* (*C.*) *anduzei*, sp. n.]—*Rev. Ent.* **15** fasc. 1–2 pp. 216–220, 6 figs. Rio de Janeiro, 1944. (With a Summary in English.)

ANDUZE (P. J.). *Aëdes* (*Ochlerotatus*) *euiris* **Dyar.** [Redescription of female and description of male.]—*Bol. Ent. venezolana* **3** no. 3 pp. 161–163, 1 fig. Caracas, 1944.

WELLINGTON (W. G.). **The Effect of Ground Temperature Inversions upon the Flight Activity of *Culex* sp. (Diptera, Culicidae).**—*Canad. Ent.* **76** no. 11 p. 223. Guelph, Ont., 1945.

On clear, calm nights, the air near the ground cools by radiation to a greater degree than does the higher air. This is known as a ground temperature inversion. In collecting *Culex* sp. in Toronto, Ontario, it was observed that when the ground temperature was 68°F. or above and there was a wind, both sexes were present within 20 feet of the ground. Males only were obtained at higher elevations. On calm nights, if the ground temperature dropped to 60°F., males were absent from the lower levels, but were abundant higher up where the air temperatures were 65°F. or more. The females remained at the lower levels. If the mean temperature of the air column fell below 60°F. no males were found and females were present at the higher levels only. The explanation of these facts is that the minimum flight temperature of the female is lower than that of the male. As a result, cliff-dwellers at Toronto may leave their porches unscreened on warm nights without being unduly troubled by mosquitos, but will suffer considerable discomfort from them if they do so on cooler nights.

CHAPMAN (R. K.). **An interesting Occurrence of *Musca domestica* L. Larvae in Infant Bedding.**—*Canad. Ent.* **76** no. 11 pp. 230–232. Guelph, Ont., 1945.

Larvae of *Musca domestica*, L., were found in an infant's mattress at Guelph, Ontario, in August 1943. Parts of the filling of the mattress, which consisted of cotton and woollen waste, were wet with urine, and the larvae were in the damp part only. Empty pupal cases were also present. Holes in the stained area of the ticking indicated that larvae and adults had been leaving through it. The larvae and the adults reared from them were all small, presumably because of the scarcity of food. As it appeared that the flies had completed their life-cycle with no other food than urine, an experiment was made to examine the possibility of this. Adult flies were given access to cotton-wool partly soaked in human urine, and the females oviposited on it. The larvae developed normally for some time and then become smaller and thinner. When a little more urine was added, they again began to thrive, and by a repetition of this process, three were brought to maturity and gave rise to small adults. When the cotton-wool was wetted with water only, females did not oviposit on it. It thus appears improbable that eggs could have been deposited on the mattress through its becoming wet at the store prior to purchase ten days before the infestation was discovered. The fly had, therefore, presumably passed through a complete life-cycle in ten days. Shortage of food commonly causes early pupation. Another case of infestation of an infant's urine-stained bedding with *M. domestica* came to light in October.

FLETCHER (F. W.). **Ortho-dichlorobenzene as an Insecticide.**—*Pests* **13** no. 3 pp. 15–16, 18, 20, 22, 24, 26, 28, 170 refs. Kansas City, Mo., 1945.

The author gives details of the physical, chemical and toxicological properties of orthodichlorbenzene, a short historical review of its use as an insecticide and a table summarising data from the extensive literature on its effect on injurious insects. This is divided into sections dealing with the main groups of pests, and in each are given the names of the insects concerned, notes on

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the methods of application and the results obtained and references to the sources of the information.

TORRES CAÑAMARES (F.). **La determinación de las especies españolas del género** *Anopheles* **Mg.** [The Identification of the Spanish Species of *Anopheles*.]—*Rev. Sanid. Hig. públ.* **18** no. 9 repr. 8 pp., 4 pls., 2 refs. Madrid, 1944.

Brief notes are given on the collection of mosquito larvae, pupae and adults and their preparation for systematic study, together with keys to the fourth-instar larvae, pupae, females and male hypopygia of the species of *Anopheles* known to occur in Spain. These are *A. plumbeus*, Steph., *A. maculipennis*, Mg., *A. hyrcanus pseudopictus*, Grassi, *A. marteri*, Sen. & Prun., *A. claviger*, Mg., *A. algeriensis*, Theo., *A. superpictus*, Grassi, and *A. hispaniola*, Theo. The author has recently found *A. marteri* in Granada and in Cuenca and concludes from this that it is probably fairly widely distributed in Spain.

MORRIS (K. R. S.). **A large-scale Experiment in the Eradication of Tsetse (*Glossina palpalis* and *G. tachinoides*).**—*Frm & For.* **5** no. 4 pp. 149–156, 1 map. Ibadan, 1944.

Sleeping sickness in the Gold Coast is most serious in the savannah forest country of the Northern Territories and is associated with *Glossina palpalis*, R.-D., and *G. tachinoides*, Westw., which also play a major part in the transmission of animal trypanosomiasis there. Their widespread distribution throughout the populated areas hampers the development of animal husbandry. *G. morsitans*, Westw., occurs over more than half of the Northern Territories, but is confined to sparsely populated country, of which it checks the development. *G. palpalis* and *G. tachinoides* are strictly riverine in the savannah country, and the climate is extremely unfavourable to them for several months of the year. It was therefore thought that it might be possible to control them sufficiently to eradicate trypanosomiasis by the clearing of fly-belt vegetation. This was begun in 1928 on the eastern cattle route [*R.A.E.*, B **21** 54] and continued at Pong Tamale [**25** 221]. Clearings for the control of sleeping sickness were begun in 1930, but work was interrupted from 1931 until 1937 and only conventional clearing was done in the intervening years. This consisted of the formation of protective clearings, designed to exclude tsetse from such places as water-holes and road and river crossings, where transmission of animal trypanosomiasis and sleeping sickness was thought to be taking place. They were found to be unsatisfactory because transmission is seldom confined to a definite, restricted area, they have never completely excluded the flies, which have been shown to travel as much as five miles along rivers in the wet season, they cause undesirable concentration of people and stock and the abandonment of land otherwise good, their upkeep requires constant effort, and the removal of all woody vegetation from an area may cause erosion of river banks, with consequent silting up of the cleared water holes so that the people are driven to uncleared river for their water.

Because of these considerations, it was decided, when anti-tsetse work was resumed in 1937, to concentrate research on the eradication of the fly. *G. palpalis* and *G. tachinoides* extend more or less continuously along water courses during the rains, but retire to well-defined, localised foci during the dry season. These foci consist of definite plant associations, and the removal of the trees and shrubs concerned in every dry-season focus throughout a whole river system results in the disappearance of these two species of *Glossina*. The work is quick and inexpensive compared with previous practices and has an immediate effect. If it is done from the headwaters downwards and very

thoroughly, the essential species of fly-belt vegetation are removed throughout the river system and re-introduction upstream is unlikely. The effect is therefore permanent.

A large-scale experiment in tsetse eradication along these lines has just been completed in Lawra district, in the north-western corner of the Northern Territory. This district, two-thirds of which is drained by the Kamba River, a major tributary of the Black Volta, forms part of a wild area of endemic sleeping sickness containing local epidemic centres and continuous with the most serious sleeping sickness region in French West Africa. The whole of it had become involved in a gradually spreading epidemic by 1930, and consequent depopulation was still in progress in 1938, through both mortality and movement of the frightened people away from the rivers. This migration had serious secondary results, as it caused over-stocking of the poorer land and allowed *G. morsitans* to spread into the depopulated areas. Clearings at some of the most highly infected villages were made in 1939, and the large-scale eradication programme was started on the Kamba River system in 1940. It was supplemented by a sleeping-sickness survey and mass treatment of the whole of Lawra district in the first half of 1941. By the end of the second dry season (March 1942), all the primary fly foci on the Kamba and its tributaries had been eliminated. This involved 105 miles of clearing in a total of 250 miles of river and tributaries. In 1943 and 1944, 60 miles of clearing were added on the neighbouring streams. At the same time, effort was concentrated on the eradication of the fly-belt vegetation on the Kamba, and at the end of 1944, more than half of the river was permanently reclaimed. On the completion of the Kamba clearing in 1942, the heavy communities of *G. palpalis* and *G. tachinoides* were eliminated. Routine catches at five observation points along the river during the wet season produced totals of less than five flies for the whole period of 1943, as against over 4,000 in the neighbouring uncleared Volta, and 2,100–5,000 per year at the same points before clearing. Clearing of the Kamba and neighbouring tributaries of the Volta has now freed 1,000 sq. miles of country from *G. palpalis* and *G. tachinoides*. A small amount of migration upstream from the uncleared Volta occurs, but this has not been found to extend beyond the lowest five miles of cleared rivers. The admission rate of new cases of sleeping sickness at Lawra hospital in the first half of 1944 showed a reduction of 90 per cent. on that in 1938. Development of the reclaimed land is progressing satisfactorily, and incidental advantages are reduction in the populations of lion, leopard and hyaena because of the removal of their favourite cover in riverine fringing forest and the opening up of good stretches of river for fishing.

G. morsitans appeared in the Kamba valley in 1940. The observation in East Africa that it lives in sparsely-inhabited, uncultivated bush and depends on large antelope for food, has been confirmed in the Gold Coast. Although it sometimes feeds on man and cattle, it never occurs in well-populated districts. Resettlement of the depopulated Kamba areas should, therefore, drive it out. However, because of its alarmingly rapid rate of increase, measures were immediately taken to control it by breaking up the large herds of game and reducing their numbers. Operations were begun on the upper river and gradually extended downstream. It had completely disappeared on the upper reaches of the river by 1944, and its numbers along the central Kamba were greatly reduced.

Data are given on the cost of the measures described against all three species, and the direct and indirect advantages of eradicative clearing are shown. Appendices contain lists of the trees and shrubs invariably associated with the presence and breeding of *G. palpalis* and *G. tachinoides* in the dry season and of those forming secondary, wet-season habitat in the north, but probably forming dry-season habitat in coastal savannah or transition forest, and notes on the procedure with regard to each group and on clearing technique.

Läuger (P.), Martin (H.) & Müller (P.). **Ueber Konstitution und toxische Wirkung von natürlichen und neuen synthetischen insektentötenden Stoffen.** [The Constitution and toxic Effect of natural and recent synthetic insecticidal Materials.]—*Helv. chim. Acta* **27** fasc. 4 pp. 892–928, 4 pls., 2 figs. Basle, 1944.

The information in this detailed account of the research that led to the discovery of the insecticidal properties of DDT has already been noticed from the first part of a shorter paper [*R.A.E.*, B **33** 76].

Adler (S.). **Observations on** *Leishmania chagasi*.—*Mem. Inst. Osw. Cruz* **35** fasc. 1 pp. 177–179, 5 refs. Rio de Janeiro, 1940. (With a Version in Portuguese pp. 173–175.)

Chagas (A. W.). **Criação de flebotomos e transmissão experimental da leishmaniose visceral americana.** [The Breeding of *Phlebotomus* and experimental Transmission of American Visceral Leishmaniasis.]—*T.c.* fasc. 2 pp. 327–333, 5 pls., 1 fldg. table. 1940.

The first of these papers is a review from the literature of the identity of *Leishmania chagasi*, the causal agent of visceral leishmaniasis in South America, and the experimental infection of *Phlebotomus* spp. with it [*cf. R.A.E.*, B **27** 200, 245–246, etc.]. It is pointed out that sandflies of the group of *P. major*, Annan., which are apparently the sole vectors of *L. infantum* and *L. donovani*, are not known to occur in America, and that *L. chagasi* has been shown to infect *P. longipalpis*, Lutz & Neiva [**27** 245], which is systematically remote from this group.

In the second paper, some of the information in which has already been noticed [**27** 245–246], the author states that an attempt was made in Brazil to rear *P. longipalpis* in the laboratory by a technique similar to that adopted for *P. intermedius*, Lutz & Neiva. The colony was begun with eggs laid by females taken in Pará, but only eight of the 30 females that were obtained from them between November 1938 and March 1939 could be induced to feed on a dog naturally infected with *L. chagasi* and these died 3–6 days later without ovipositing. Six of them showed leptomonads in the digestive tract. A hamster into which suspensions of four females of *P. intermedius* that had fed on the dog were injected in March–April 1939 showed infection in January 1940. Another hamster into which suspensions of three infected females were injected in January–March 1939 showed no infection on death towards the end of the latter month.

Martins (A.), Versiani (V.) & Tupínambá (A.). **Estudos sobre a tripanosomiase americana em Minas Gerais, Brasil.** [Studies on American Trypanosomiasis in Minas Gerais, Brazil.]—*Mem. Inst. Osw. Cruz* **35** fasc. 2 pp. 285–301, 1 pl., 4 graphs, 3 fldg. tables. Rio de Janeiro, 1940.

Studies on human trypanosomiasis caused by *Trypanosoma* (*Schizotrypanum*) *cruzi* were begun in the State of Minas Gerais, Brazil, in 1937. The first phase of the work was the collection of Triatomid bugs and examination of them for infection, and the results are given in tables and discussed in some detail. In all, 7,326 bugs were collected from 118 municipalities situated throughout the State, even in forest regions in which Triatomids were thought not to occur. They comprised 5,847 examples of *Panstrongylus megistus*, Burm. (79·81 per cent. of the total), 712 of *Triatoma* (*Eutriatoma*) *sordida*, Stål (9·72 per cent.), 681 of *T. infestans*, Klug (9·29 per cent.), 66 of *T. brasiliensis*, Neiva (0·9 per cent.) and small numbers of *P. geniculatus*, Latr., *T.* (*E.*) *maculata*, Erichs., *T. vitticeps*, Stål, *T. chagasi*, Brumpt & Gomes, *T. rubrofasciata*, Deg., *Rhodnius*

domesticus, Neiva & Pinto, another species of *Rhodnius*, probably undescribed, and *Psammolestes coreodes*, Bergr., which was found only in the nests of a bird. *Panstrongylus megistus* occurred throughout the State, *T. infestans* in the southern regions, where it was the predominant species, and *T. sordida* in the north and west. Infection with the trypanosome was determined by examination of the contents of the hind gut of all the available stages of eight species. The percentages found infected were 41·25 for *P. megistus*, 14·97 for *T. infestans*, 10·6 for *T. brasiliensis* and 6·6 for *T. sordida*. A male and a female of *T. vitticeps* were both infected, but infection was not found in small numbers of *Rhodnius* sp., *P. geniculatus* or *T. maculata*. The infected bugs came from 82 municipalities situated throughout the State.

Studies on the epidemiology of the disease were begun in 1939, and some of the results are given of work in a settlement consisting of about a dozen huts in the central region. The flora and fauna of the district are briefly described. Triatomids were found in all the dwellings, but were not numerous in any, and 82·2 per cent. of them were infected with *Trypanosoma cruzi*. They consisted principally of *P. megistus*, with the addition of a few examples of *Triatoma sordida*. Examination of the inhabitants and of wild animals was begun ; the latter were negative for *Trypanosoma cruzi*, but *T. minasense* was found in a monkey (*Callithrix penicillata*).

Dias (E.). **Técnica do xenodiagnostico na molestia de Chagas.** [The Technique of Xenodiagnosis of Chagas' Disease.]—*Mem. Inst. Osw. Cruz* **35** fasc. 2 pp. 335–342, 2 pls., 8 refs. Rio de Janeiro, 1940. (With a Summary in English.)

The best indirect method of diagnosing Chagas' disease, caused by *Trypanosoma* (*Schizotrypanum*) *cruzi*, is xenodiagnosis, in which the Triatomid vectors of the trypanosome are allowed to feed on the suspected carrier and subsequently examined for infection. In Brazil, the Triatomids are bred in the laboratory, care being taken to keep the stock free from all flagellates, and nymphs are used in the tests, since they ingest a comparatively large quantity of blood and mortality among them is slight. The number used in each test is 3–6. The species of Triatomid selected for the test in a given region should be a local vector, since there is some variation in susceptibility to infection with different strains of the trypanosome. Thus, it has been shown that the percentage of infection with a Brazilian strain is significantly higher in *Panstrongylus megistus*, Burm., *Triatoma* (*Eutriatoma*) *sordida*, Stål, and *T. infestans*, Klug, than in *Rhodnius prolixus*, Stål, and with Venezuelan strains in *R. prolixus* than in *P. megistus* or *T. infestans*. The bugs are fed on the suspected case until they are engorged, which usually takes 15–30 minutes ; they are then kept in tubes for at least a month before being examined, 40–60 days being the optimum period. Infection is detected by examination of the contents of the hind gut, removed by means of a pipette, or, if this is negative, by dissection and examination of the intestiform portion of the mid-gut, and both these processes are briefly described.

Neiva (A.) & Lent (H.). **Estudos sobre Triatomideos do Chile : interessante caso de provavel polimorfismo.** [Studies on the Triatomids of Chile. An interesting Case of possible Polymorphism.]—*Mem. Inst. Osw. Cruz* **35** fasc. 2 pp. 343–363, 6 figs., 27 refs. Rio de Janeiro, 1940.

Commenting on their previous paper and that of Mazza, Jörg & Gajardo Tobar [*R.A.E.*, B **30** 14], the authors point out that the latter erected the genus *Mepraia* for *Triatoma spinolai*, Porter, on the ground that the females were apterous. They consider that these females belong to a distinct species, apterous in both sexes, which they described as *Triatomaptera porteri*, and that

Mepraia should not be used for this species, as it was proposed for *Triatoma spinolai*, or for the latter, which is correctly included in *Triatoma*. They discuss the possibility that the winged and wingless forms are examples of alar polymorphism in a single species, but consider that this should not be accepted until it has been proved by breeding experiments. They regard *T. chilena*, Usinger, as a synonym of *T. spinolai*.

Dias (E.). **Sobre um** *Schizotrypanum* **dos morcegos** *Lonchoglossa ecaudata* **e** *Carollia perspicillata* **do Brasil.** [On a Trypanosome of the Bats, *L. ecaudata* and *C. perspicillata*, from Brazil.]—*Mem. Inst. Osw. Cruz* **35** fasc. 2 pp. 399–409, 1 pl., 2 tables (1 fldg.), 27 refs. Rio de Janeiro, 1940. (With a Summary in English.)

Dias (E.) & Pifano C. (F.). **Estudo experimental de um** *Schizotrypanum* **do morcego** *Hemiderma perspicillatum* **da Venezuela.** [An experimental Study of a Trypanosome of the Bat, *H. perspicillatum*, from Venezuela.]—*Op. cit.* **36** fasc. 1 pp. 79–98, 2 pls., 22 refs. 1941.

A description is given in the first paper of a species of *Trypanosoma* (*Schizotrypanum*) morphologically resembling *T.* (*S.*) *vespertilionis* that was found in *Lonchoglossa ecaudata* and *Carollia perspicillata* from Brazil. It did not develop in examples of *Panstrongylus megistus*, Burm., *Triatoma infestans*, Klug, or *Rhodnius prolixus*, Stål, that were fed on infected bats.

It is recorded in the second that a trypanosome closely resembling *T.* (*S.*) *phyllostomae* was found in another bat, *Hemiderma perspicillatum*, from Venezuela. A description of it is given, and it is stated to differ biometrically from all the other species of the genus under observation, including *T.* (*S.*) *cruzi*. It proved pathogenic in the laboratory to dog, mouse and guineapig and was still infective for *H. perspicillatum* after repeated passages through laboratory animals. It developed readily in *R. prolixus*, *P. megistus*, *P. geniculatus*, Latr., *Triatoma infestans*, *T.* (*Eutriatoma*) *nigromaculata*, Stål, *T.* (*E.*) *maculata*, Erichs., *T.* (*E.*) *sordida*, Stål, *Psammolestes arthuri*, Pinto, *Cimex hemipterus*, F., and *Ornithodoros moubata*, Murr., the process of development being the same as that of *Trypanosoma cruzi* and terminating with the appearance of metacyclic forms in the hind gut.

[**Mosquito Control Work in 1943.**]—*Proc. N. J. Mosq. Ext. Ass.* **31** 201 pp., text ill., refs. New Brunswick, N.J., 1944.

This report is similar in arrangement to previous ones [*R.A.E.*, B **32** 131, etc.] and includes, in addition to the papers noticed below, accounts of mosquito control work in various parts of the United States, which are primarily of local interest or have particular reference to the army and conditions brought about by the war, and **A Review of Contributions to the Knowledge of Mosquitoes made during 1943 in a World at War,** by F. C. Bishopp & H. H. Stage (pp. 7–29).

Anopheles quadrimaculatus **in north-eastern United States,** by R. C. Barnes & H. L. Fellton (pp. 48–51, 13 refs.), contains references to records dealing or thought to deal with the occurrence of *Anopheles quadrimaculatus*, Say, in the north-eastern States and also brief results of surveys in the course of which it was found in 1941–43 in Delaware by C. B. Huffaker and in 1943 in Massachusetts, New York and New Jersey by the United States Public Health Service. It was not found in surveys made in Pennsylvania. It has, however, been recorded from all the north-eastern States except Vermont, and its occurrence in that State seems most probable.

In **A successful Outlet for Drainage Channels through Sand Beaches** (pp. 68–72, 1 fig.), O. W. Lafferty deals with drainage on the Delaware Bay coast of Cape May County, New Jersey, where erosion is severe and the displaced sand

and gravel are sometimes deposited so as to close the outlets of creeks. In choosing a method of dealing with the enclosed marshes to prevent mosquito breeding, the type of outlet appropriate to the area to be drained, the relative level of marsh and tide water, and suitable tide gate control must be considered in each case. A square foot of opening should be provided at least to every 50 acres of marsh, preferably to every 25 acres. Various materials that may be used and the construction of an outlet designed by T. D. Mulhern are discussed.

In **Research with Mosquito Larvicides on Mosquitoes and Fish in 1943** (pp. 102–104), J. M. Ginsburg describes experiments on the effect on fish of unemulsified kerosene, unemulsified mosquito oil (equal parts of two kinds of fuel oil) and three emulsions that gave satisfactory kills of mosquito larvae and pupae in field tests of substitutes for pyrethrum. The three stock emulsions contained, respectively, 66 per cent. tar oil solvent, 66 per cent. Velsicol solvent, and 60 per cent. kerosene, 6·5 per cent. orthodichlorbenzene, 0·2 per cent. phenothiazine (thiodiphenylamine) and 1·5 per cent. acetone, and each was prepared with 0·5 per cent. commercial sodium lauryl sulphate and water to make the volume up to 100 per cent. and was diluted with ten parts water just before spraying. At this dilution, there is no risk of fire, but some injury may be caused to plants. The larvicides were applied at 50, 100 and 200 U.S. gals. per acre. The New Jersey pyrethrum larvicide [an emulsion of oil containing pyrethrum extract (**23** 205)] was tested as a control at the same rates and had no effect on any of the three species of fish used. The larvicides containing tar oil and Velsicol solvents killed all fish at 50 U.S. gals. per acre. The other emulsion did not affect the fish at the lowest dosage but began to do so at 100 U.S. gals. per acre and killed all at the highest dosage. Kerosene did not harm them at 50 U.S. gals., but at 100 one species was definitely affected. Mosquito oil was detrimental to the same species at 50 U.S. gals. and to all three at 100 U.S. gals.

In **Mosquitoes caught in Back Yards of Poliomyelitis Cases in Chicago during the Infantile Paralysis Epidemic of 1943,** by J. L. Clarke (pp. 105–111, 4 figs.), an account is given of mosquito surveys in the areas of Chicago concerned in an epidemic of poliomyelitis that occurred in August and September. Water, milk, sewage, food, birds, rats, mice, flies and conditions of cleanliness varied considerably from one infected district to another, but mosquitos were present in all of them. Light-traps in the back yards of premises in which poliomyelitis cases occurred caught 3,819 examples of *Culex pipiens*, L., 746 of *Aëdes vexans*, Mg., 376 of *Uranotaenia sapphirina*, O.-S., 32 of *C. tarsalis*, Coq., and smaller numbers of *C. apicalis*, Adams, *Culiseta* (*Theobaldia*) *inornata*, Will., *Anopheles quadrimaculatus*, Say, and *Aëdes trivittatus*, Coq. These mosquitos were macerated and the material used to inoculate four monkeys. Results were negative. Two rhesus monkeys [*Macaca mulatta*] and two other monkeys (*Cebus*) were then caged with 600 mosquitos caught in October, but the mosquitos did not bite readily. In a third experiment, 13,000 adults of *Culex pipiens* bred from larvae were confined for two days and given the opportunity of feeding on poliomyelitis virus in the form of faeces and spinal cord recovered from cases in the epidemic, but none was seen to feed freely. They were then released in a cage containing two rhesus and two *Cebus* monkeys, and one-third of the mosquitos fed on the monkeys during the first week, but infection was not transmitted. Six monkeys were inoculated with poliomyelitis virus for the fourth experiment and placed in a cage, and six uninfected monkeys were placed in another cage, 16,000 individuals of *Culex pipiens* having access to all the monkeys. Very few mosquitos fed, and 90 per cent. of them had died before the inoculated monkeys developed the disease. Results were negative. In the fifth experiment, 3,000 individuals of *Aëdes aegypti*, kept in batches of 200 in lantern chimneys, were given water only for four days and then allowed to feed on poliomyelitis virus and defibrinated horse blood. After this, the chimneys were placed over immobilised

monkeys each day for 30 days. The mosquitos fed for the first two days, 75 per cent. obtaining blood meals, and again fed readily at the end of the first, second, third and fourth weeks. Four of the five monkeys (two *Cebus* and three rhesus) developed high fevers 16 days after exposure to the infected mosquitos; they were killed 22 days later, but the results of spinal cord examination were not available when the paper was written.

In **Improved Methods of rearing *Aëdes aegypti* Mosquitoes for Use in Repellent Studies** (pp. 161–168, 4 figs., 4 refs.), P. Granett & H. L. Haynes describe a combined water softener and filtering apparatus and a modified procedure that together made it possible to increase the number of *Aëdes aegypti*, L., reared each week for repellent studies at Rutgers University, New Jersey, from 3,000 to 12,000–15,000, while the handling time was increased only from 18 to 22 hours per week. Tap water had previously been found unsuitable, and distilled water was not available in sufficient quantities. Mortality in the treated water was 10 per cent. higher than in distilled water, but a mixture of 80 per cent. treated water and 20 per cent. distilled water gave results equivalent to those obtained with distilled water alone (95 per cent. survival). When supplemented with nutrient salts, the treated water was a satisfactory medium for the immature larvae of *Anopheles quadrimaculatus*, Say.

Aëdes aegypti is reared in a building with inside temperature and relative humidity controlled at 74°F. and 60 per cent., and circulating air with one complete change every hour. The adults are kept in cubical screen cages with sides 2 ft. long and fed on 5 per cent. dextrose solution and distilled water, and the females receive blood meals also. Eggs are laid on filter paper in jars half filled with distilled water. The papers bearing the eggs are collected regularly, placed on blotters to absorb surplus water, dated and stored in a closed glass container. Cotton-wool soaked with water is kept in the container below but not in contact with the eggs. Under these conditions, they remain viable for several weeks. Three days a week, enough eggs to yield at least 4,000 larvae are placed in a small glass jar filled with distilled water. The young larvae hatch in about an hour, and batches of 550 are placed in jars containing 400 cc. distilled water. A water suspension of 1·5 gm. Fleischmann's yeast and 0·15 gm. blood albumen is added as food, and the larvae and food are then transferred to pans 8½ ins. wide, 12 ins. long and 2 ins. deep, one jarful per pan, and the pans are filled with 1,600 cc. treated water and kept on racks in a constant temperature cabinet at 82°F. On the fourth day, the larvae are transferred to fresh water (80 per cent. treated and 20 per cent. distilled) and fresh food is added at twice the original concentration. The pupae appear at the end of the fifth day and within a few hours are strained off and transferred to 400 cc. jars containing treated or distilled water to which a small amount of calcium carbonate has been added. The pupae from two pans are put into each jar, and a few pieces of cork are placed on the water to help the emerging adults. The jars are covered with gauze-topped lids and returned to the constant temperature cabinet for 24 hours. When emergence begins, they are placed in small holding cages and the lids are removed. All the adults have usually emerged after two days. The sugar solution and distilled water are supplied as food. Repellents are tested on 1,000–4,000 adults 4–6 days old.

Some practical Suggestions for the Rearing of *Aëdes aegypti* (Linn.) (pp. 168–172, 6 refs.) by H. L. Trembley deals with methods and equipment used in rearing 1,200 females of *Aëdes aegypti*, L., per week for experimental purposes in a laboratory of the United States Public Health Service in Maryland. The eggs are laid on filter papers placed on moist cullucotton pads in dishes that form the bases of lantern-globe cages, and are kept moist for 2–3 days at room temperature [*cf. R.A.E.*, B **23** 70], then dried in the open air and stored in a covered container. They should be used within three months. Papers bearing eggs are immersed for several minutes or hours, dried and re-submerged for additional hatching. Almost complete hatch can be obtained by repeated

submergence of properly matured and dried eggs. They are put to hatch in photographic trays measuring 16 by 9½ by 2 ins. and containing not less than three litres distilled water with the addition of food (oat grains cut in half alone or with dog biscuits) put in 12–24 hours in advance or 150 cc. water from an old pan introduced just before the eggs. The presence of bacteria and organic material reduces the oxygen content of the water and so stimulates hatching of the older eggs [*cf.* **29** 163]. About 300 larvae are allowed to each tray, and 12–30 oat grains and sometimes dog biscuits are added daily. A temperature of 27°C. [80·6°F.] gives maximum pupation in 7–9 days, but larval development can be accelerated or retarded by adjustment of temperature without apparent ill effect. Preliminary experiments indicated that irradiation by a carbon arc lamp at 36–72 ins. for 3–5 minutes daily will stimulate larvae that are lagging in development. Pupae are removed from the pans with a medicine dropper, and about 100 females and 10 males are transferred to each 500 cc. beaker or 250 females and 25 males to a 1,500 cc. beaker. The excess male pupae are destroyed. Each beaker is covered with a bobbinet top. Adults emerge in 36–60 hours at 27°C., and are kept in a large stock colony cage or in batches of 50 in lantern-globe cages, usually the latter. Filter paper is provided for oviposition. The lantern globe cages, small containers for experiments with individual mosquitos and a device for effecting transfer from them are described. Adults are fed through the bobbinet covering the top of the lantern globe on fruit or 5 per cent. dextrose solution. Chicks are generally used for supplying blood-meals to females in the rearing colony, but any available animal can be substituted. Engorged females are removed from the cage with a suction tube and confined in lots of 50 in the globe cages where they oviposit within 2–7 days. A temperature of 26–29°C. [78·8–84·2°F.] is satisfactory, and relative humidity must remain above 60 per cent.

In **"Paired Product Testing" for the Evaluation of Mosquito Repellents** (pp. 173–178, 2 refs.), P. Granett points out that even when laboratories use similar methods of testing repellents, their results, expressed as absolute repellent time, vary greatly. However, the relative performance of a pair of repellents as determined by each laboratory, is roughly constant. Relative performance is therefore of greater significance than absolute performance, and information on this can be provided by a method, here called "paired product testing," based on the simultaneous test of a pair of repellents on two arms or legs of the same individual. For each repellent, a record is kept of the "protection or repellent time" or the time between applying the substance and receiving the first bite on the treated area. The method is simple, which is a great advantage as different species of insect react differently to a repellent and must therefore be tested separately. The test procedure is described with special reference to mixed mosquito populations. A list is given of variables that affect the protection time of a given repellent.

ADAM (N. K.). **A rapid Field Method for assessing the Spreading Power of anti-malarial Oils.**—*Bull. ent. Res.* **36** pt. 3 pp. 269–272, 4 refs. London, 1945.

To cover the surface of stagnant water as an effective mosquito larvicide, an oil must have a higher spreading power than would be required on clean water, as the surface tension of most stagnant waters is very much reduced by surface films. A simple method of assessing the spreading power of an oil is to compare it with a standard liquid, of which the spreading power has been determined in the laboratory, by placing drops of each on water and observing which spreads against the other [*cf. R.A.E.*, B **33** 26.] The standard should be non-volatile and insoluble in water or nearly so, and have a spreading pressure that does not vary in waters of different acidities. The last requirement excludes all fatty acids and most vegetable oils; the spreading pressure

of castor oil [*cf. loc. cit.*] varies from less than 20 dynes per cm. on water with a pH of about 5·5 to more than 30 on water with a pH of 8·5, and samples differ in the extent to which their spreading pressure changes with acidity. The spreading pressure of alcohols is constant on acid and alkaline water, and that of the esters of such fairly soluble acids as phthalic and salicylic is also constant. Temperature has but a slight effect on spreading pressure. By dissolving a spreading substance in a highly refined, non-spreading mineral oil, such as medicinal paraffin, the spreading power can be adjusted to any desired value. Terpineol and technical oleyl alcohol, which have spreading pressures of 36 and 47 dynes per cm. at 20°C. [68°F.] are very suitable for use in this way, and dimethyl phthalate, dibutyl phthalate, methyl salicylate and ethyl salicylate, with spreading pressures of about 21, 21, 13 and 13 dynes per cm., respectively, are also good standards. A table is given of the spreading pressures of various solutions of terpineol and oleyl alcohol in medicinal paraffin.

Spreading pressures are best compared on clean water surfaces, which may be obtained in an upright funnel by running the water into the stem and letting it overflow. Enough of the standard or unknown oil is placed on the surface to leave at least one drop about a quarter of an inch across after the film has covered the whole surface. When the first liquid has spread, a drop of the other is put on the surface. If it has a smaller spreading pressure than the first, it remains as a droplet, and some idea of the extent of the difference can be obtained from the shape of the drop. If it has the greater spreading power, it pushes back the film of the first liquid and displaces it. The rate of spreading of the second drop is some guide to the difference in spreading pressure between the two, but not a very reliable one. To make a fairly accurate determination, successive trials should be made with a number of standards until two are found, one a slightly more powerful, the other a slightly less powerful, spreader than the oil that is being tested. If there is doubt whether spreading has occurred, the film can be made more visible by dusting the surface of the water lightly with talc. If it is necessary to make tests on the water where the larvae may breed, separate surfaces can be used for the various comparisons if small in extent. The funnel technique can be applied to water from a pond, if a small tank is arranged from which it can run into the stem of the funnel. Great care must be taken to avoid contamination of the water, which may occur from perspiration if a finger is dipped in it.

BARNES (S.). **The residual Toxicity of DDT to Bed-bugs** (*Cimex lectularius*, **L.**).—*Bull. ent. Res.* **36** pt. 3 pp. 273–282, 5 refs. London, 1945.

The DDT used in these tests was the pure para para compound, free of isomers, with a melting point of 109°C. Blocks of materials commonly used in the construction of buildings were sprayed with a 4 per cent. solution in a mixture of light oil (odourless distillate) and ethylene dichloride (9 : 1), and dried at room temperature. Examples of *Cimex lectularius*, L., were exposed on the dry deposit for 24 hours, and mortality counts were made after six days. During the intervals between tests, the blocks were hung on a wall facing a window. The results are given in detail. Mortalities were generally higher with the heavier deposits of DDT. A deposit of 0·23 mg. per sq. cm. was necessary on cement, plain wood and old painted wood to give complete mortality 48 hours after application. This deposit on newly painted wood caused only 44 per cent. mortality [*cf. R.A.E.*, B **32** 201], whereas on glass, 0·06 mg. gave complete kill. The toxicity of the different surfaces one month after they received the heavier deposits (0·06–0·23 mg.) diminished little, if at all. Toxicity fell considerably with the lighter deposits, particularly on newly painted wood. Three months after treatment, glass that had received deposits

ranging from 0·007 to 0·06 mg. still gave a minimum kill of 69 per cent.; cement and plain wood alone of the remaining surfaces gave a similar kill (80 and 77 per cent.) and then only when they had received 0·23 mg. They gave about 60 per cent. mortality after six months with 0·23 mg. and glass a slightly higher mortality with 0·03.

The toxicity one month after treatment of blocks of old painted wood left unused until then did not differ appreciably from that of blocks that had been used for a test 48 hours after treatment, so that removal of the large, visible crystals with which the bugs exposed after 48 hours soon become covered apparently did not cause loss of toxicity. Dusting or washing with cold water removed most if not all of the small crystals from a smooth surface (glass or painted wood) and reduced its toxicity considerably [*cf.* **32** 198]. Exposure of bugs for various periods up to 24 hours on filter papers, unpainted wood or glass treated with different quantities of DDT dissolved in acetone suggested that lengthening exposure beyond one hour did not increase the percentage mortality. Surprisingly low mortality among bugs exposed for 24 hours on glass or wood bearing a deposit of 1 or 5 mg. DDT per sq. cm. suggested, in conjunction with the results of the first experiment, that the toxicity of a material sprayed with DDT is greater when a slowly volatilising solvent is used, and further experiment with dry deposits confirmed this. Filter papers were then impregnated with 1 mg. DDT per sq. cm. and half of each was sprayed with odourless distillate while the other half was left without oil. Mortalities among bugs exposed for half an hour on the dry halves and halves having deposits of 0·36, 1·44 and 2·88 mg. oil were 7, 53, 57 and 100 per cent., and among bugs exposed for 24 hours 33, 80, 100 and 100 per cent., respectively. The toxicity of odourless distillate alone was negligible. The low toxicity of the rubbed surface of old painted wood was greatly enhanced by spraying with oil to give a deposit of 0·18 mg. per sq. cm. Such a fine oil film would not be a serious inconvenience in an inhabited room and, as it takes 48 hours to evaporate, bugs would have ample time to come in contact with it. A second oil spray after the first had dried did not again increase toxicity.

During tests of the toxicity to *C. lectularius* of many substances that were either isomers of DDT or had structural formulae analogous to it, only di-(4-methoxyphenyl) trichlorethane (referred to as S13) was as toxic as DDT when used as a direct spray. When sprayed directly on to bugs in odourless distillate, pyrethrum extract and crude benzene hexachloride gave complete mortality at one-tenth the concentration of active ingredient (0·0004 mg. total pyrethrins or gammexane [**33** 130] per sq. cm.) required to give a kill of the same order with DDT [*cf.* **32** 206] or S13. With equal deposits, pyrethrum was more effective than the last two 24 hours after application to cement as a residual spray, but whereas the toxicity of these was still considerable seven weeks later (80 per cent. kill or over at 0·6 mg. per sq. cm.) that of pyrethrum was negligible (13 per cent.). Benzene hexachloride at 0·007 mg. gammexane per sq. cm. gave 63 per cent. kill after seven weeks and was more effective 24 hours after application than about ten times as much DDT or S13. However, it was completely ineffective after five months, whereas the other two still showed some toxicity. Lethane 384 Special (12·5 per cent. β-butoxy–β′-thiocyanodiethyl ether, 37·5 per cent. β-thiocyanethyl laurate, 50 per cent. odourless distillate), when used at ten times the rate that gave a high mortality in the case of DDT, was much less effective as a direct spray, but the initial toxicities of the two at these relative rates as residual sprays were comparable. Seven weeks after application, the toxicity of Lethane 384 Special was comparable only to that of DDT at one-twentieth of its concentration. The toxicity of a cement surface treated with DDT five months previously was not greatly increased by spraying with odourless distillate to give an oil deposit of 0·36 mg. per sq. cm. and that of a cement surface treated with S13 or benzene hexachloride was not increased at all by spraying with oil.

HADDOW (A. J.). **The Mosquitoes of Bwamba County, Uganda. III. The vertical Distribution of Mosquitoes in a Banana Plantation and the biting Cycle of** *Aëdes* **(*Stegomyia*) *simpsoni*, Theo.**—*Bull. ent. Res.* **36** pt. 3 pp. 297–304, 3 graphs, 5 refs. London, 1945.

The vector in outbreaks of yellow fever in man in Bwamba County, Uganda, is considered to be *Aëdes simpsoni*, Theo., but the epidemiology involves the persistence of the disease in an endemic form, transmitted by sylvan mosquitos, among the animals of the Semliki Forest [*cf. R.A.E.*, B **33** 189–190]. Over 60 per cent. of Bwamba monkeys are immune from yellow fever, and the virus has recently been isolated from species of *Aëdes*, not including *A. simpsoni* or *A. aegypti*, L., taken in uninhabited virgin rain-forest. An account is here given of the results of catches made to investigate further the biting habits of *A. simpsoni* and obtain additional evidence of the activity of forest mosquitos in banana plantations [*cf. loc. cit.*]. On ten occasions, catches with human bait, each lasting 24 hours, were made simultaneously in a banana plantation at ground level, and on platforms at heights of 6 ft. (among the leaves of the young banana plants), 12 ft. (among the leaves of the full-grown plants and the bunches of bananas) and 18 ft. (in the open air above the plants). Each hour's catch from each level was recorded separately. The number of each species taken at each level is shown. The catches comprised five species of *Anopheles*, four of *Mansonia* (*Taeniorhynchus*) and five of *Aëdes*, and also *Eretmapodites chrysogaster*, Graham, and some undetermined species of *Culex*. *A. simpsoni*, which was diurnal, and *M.* (*T.*) *africana*, Theo., which was taken by day and night, represented 596 and 46 of the total of 687 mosquitos. Two other species were caught by day only and the rest only by night. *A. simpsoni* was prevalent at all altitudes, and though its numbers decreased somewhat with increasing height, its abundance at 12 ft. indicated that an infected monkey among a band from the forest robbing a plantation could easily infect it. The principal raiding monkey in Bwamba is *Cercopithecus nictitans mpangae*, of which 25 out of 41 individuals examined were found to be immune from yellow fever. *M. africana* was fairly evenly distributed at ground level and 6 and 12 ft. but very scarce at 18 ft. Several of the other species taken were sylvan, though the nearest forest was half a mile away.

The biting cycle of *A. simpsoni* at the different levels is analysed by four-hour periods for the hours of daylight, and the combined figures for all levels by one-hour periods are also shown. The main factors decreasing its activity appeared to be cold, wind and direct hot sunshine. It was most active on warm, cloudy days [*cf.* **31** 182].

RIBBANDS (C. R.). **The Use of DDT as a Mosquito Larvicide on still Waters.**—*Bull. ent. Res.* **36** pt. 3 pp. 315–330, 3 refs. London, 1945.

An account is given of experiments carried out in Ceylon and Assam in 1944 on the effectiveness of DDT as a mosquito larvicide on still waters. The following is almost entirely based on the author's conclusions. The DDT used was a crude product containing 73 per cent. of the para para compound. It was dissolved in oil at the rate of 1 oz. per pint (5 per cent.) and was equally effective in waste engine oil, malariol and kerosene. At the rate of 1 pint per acre, the solutions were lethal to all larvae of *Anopheles* spp. and other mosquitos within 24 hours under optimum conditions ; at 0·2 pint per acre, they produced 75 per cent. mortality within one day and complete mortality within three days. Waste engine oil alone, at 2 gals. per acre, caused no decrease in numbers of large Anophelines within 24 hours, but completely eliminated larvae by the fifth day ; at 8 gals. per acre under optimum conditions without rain, it prevented the development of Anopheline larvae for 28 days. When DDT was added to the waste oil, this effect was continued for a further four days, when the experiment terminated. The residual effects of DDT in oil

were much greater on larvae of Anophelines than on those of other mosquitos, and the initial lethal effects were slightly greater. DDT in oil had no considerable effect as an ovicide or deterrent against oviposition. DDT and Paris green when applied in dusts were similar in their effects. The minimum dose that was effective against Anopheline larvae within one day was 8 oz. per acre.

It appears probable that the most important advantage of DDT in oil is that it is lethal in the stable and far-reaching monomolecular oil film, whereas the ordinary larvicidal oils are lethal only in the less stable and less easily obtainable thick films. This property enables a toxic film to spread rapidly over a very large area from the point of application, and makes practicable the application of doses at intervals only. When the solution of DDT in waste oil was applied to the edges of various types of pond, the minimum lengths of edge completely cleared of Anophelines 24 hours later were 7 ft. by 0·25 cc. and 1 cc., 23 ft. by 2 cc., 25 ft. by 4 cc., and 40 ft. by 8 cc. The average lengths were considerably greater. Lethal spread was greatest in ponds containing moderate quantities of surface vegetation, and least in those densely packed with *Pistia* and in completely open water. Rain had no marked and consistent effect on the distance covered by the toxic film : it reduced it on fairly open water and increased it on water densely packed with *Pistia*. Larvae were successfully eliminated from a large marsh by throwing DDT in oil on to the water surface at 12 ft. intervals, at the rate of 2 pints per acre. No apparatus is necessary when such a method is used, but oil squirts, sending out a measured dose over a distance of several feet, are simple and convenient.

De Meillon (B.), Golberg (L.) & Lavoipierre (M.). **The Nutrition of the Larva of *Aëdes aegypti* L. I.**—*J. exp. Biol.* **21** no. 3-4 pp. 84-89, 8 refs. London, 1945.

The following is based on the authors' introduction and summary. From a practical point of view the nutrition of mosquito larvae may be of great importance. If, for example, the lack of certain essential growth factors explains the well-known problem of the absence of larvae from an apparently suitable breeding place, it might be possible to inhibit or destroy one or more of these factors as a measure of control. In nature, some of the growth factors required by mosquito larvae are synthesized for them by other organisms living in the same medium ; but as non-essential substances are no doubt synthesized at the same time, it becomes necessary to perform all experiments under sterile conditions.

Experiments on the nutrition of larvae of *Aëdes aegypti*, L., were therefore begun. It is known that they can utilise solutes [*R.A.E.*, B **18** 234], and it was desired to replace yeast and liver, which together provide a diet adequate for their growth and metamorphosis [**23** 237], by other substances, so as to provide a completely synthetic diet. The technique and a method for accurate recording and interpretation of the results are described.

First-instar larvae were kept in agglutinating broth for up to 96 hours without affecting their subsequent growth in suitable media. A suspension of autoclaved brewer's yeast in calcium-chloride solution supported growth and metamorphosis of the larvae. The addition of filtered liver extract greatly improved the growth and survival rates. Further addition of a mixture of vitamins of the B group brought about no corresponding further improvement ; neither did replacement of the liver extract by papaic liver digest, with or without the vitamin mixture. Storage of dried brewer's yeast for a long period, or of autoclaved fresh brewer's yeast for a shorter period, had a marked adverse effect on the growth rate when these yeasts were combined with liver extract or vitamin mixture. A similar effect was brought about by prolonged autoclaving of the yeasts. In all these media liver extract could be replaced

by the mixture of B vitamins. It was not found possible, however, to replace the solid yeast fraction of the medium by any combination of substances so far investigated.

The time taken for the change from pupa to adult was independent of the medium in which the larva was grown, but some further factor that causes the emergence of vigorous adults in nature or in contaminated media was found to be largely absent from the best of these experimental media, such as brewer's yeast and liver.

GOLBERG (L.), DE MEILLON (B.) & LAVOIPIERRE (M.). **The Nutrition of the Larva of *Aëdes aegypti* L. II. Essential water-soluble Factors from Yeast.**—*J. exp. Biol.* **21** no. 3–4 pp. 90–96, 20 refs. London, 1945.

The following is the authors' summary of an investigation dealing with the water-soluble factors in yeast that are essential for growth and survival of mosquito larvae [*cf.* preceding abstract].

Autolysis products of fresh brewer's yeast, tested for their ability to promote growth of larvae of *Aëdes aegypti*, L., revealed the loss of an essential part of the activity of the original yeast. Under suitably modified conditions this loss could be avoided. A basal medium comprising the water-insoluble factor of brewer's yeast, glucose, salt mixture and yeast nucleic acid requires supplementation with thiamin, riboflavin, nicotinic acid, pantothenic acid and possibly with biotin in order to permit larval growth to the fourth instar. For pupation, one further factor appears to be necessary, namely, folic acid. Its effect is specific, for it cannot be replaced by xanthopterin or thymine. It exercises an important effect also on growth and survival rates, bodily pigmentation and size of the larvae. The following substances when added to or withheld from various media did not appear to influence growth or survival of the larvae ; other vitamins of the B group, ámino-acids, purines, pyrimidines, glutathione, ascorbic acid and possibly vitamin K. Transference of larvae from a folic acid-free medium to one containing the vitamin, and *vice versa*, revealed that the presence of folic acid seems to have its most vital effect during the third stage of larval life.

DA SILVA RAMOS (A.) & UNTI (O.). **Notas sôbre os anofelinos de São Vicente e suas imediações.** [Notes on the Anophelines of São Vicente and Neighbourhood.]—*Arq. Hig. Saúde públ.* **5** no. 10 pp. 53–58, 2 pls., 3 refs. São Paulo, 1940. (With Summaries in English and French.)

Observations on the Anopheline fauna of São Vicente, in the State of São Paulo, Brazil, where malaria is endemic, were made in August 1939 when the temperature varied from 18 to 29°C. [64·4 to 84·2°F.] and there was practically no rain. The principal breeding places were almost always found to be excavations, disused potters' pits and marshes. The numerous ditches were usually free from larvae and showed signs of recent oiling. Observations were made on the content of chlorine as chlorides and, in a few cases, the pH of water in breeding places and water judged suitable for breeding though not containing larvae [*R.A.E.*, B **34** 9]. Immature stages were usually found in water with a chlorine content of 0·010–0·065 parts per mille. Fourth-instar larvae of *Anopheles oswaldoi oswaldoi*, Peryassú, were found in water containing 7·005 parts per mille and connected with a sea-water ditch. The other identified species of *Anopheles* found were *A. strodei*, Root, *A. albitarsis*, Arrib., *A. intermedius*, Chagas, *A. maculipes*, Theo., and one thought to be *A. mediopunctatus*, Theo. The number of each taken, the locality and nature of the breeding place, and the localities where adults were caught with animal bait are shown. Adults were sought but not found on 43 occasions in dwellings in areas where larvae were taken and adults caught on animal bait.

Records made in the district in earlier years are quoted for comparison, and notes are given on the morphology of the eggs of *A. oswaldoi oswaldoi*, *A. intermedius*, and the species thought to be *A. mediopunctatus*.

DE CARVALHO FRANCO (A.). **O *Rivulus santensis* como elemento de combate às larvas anofelinas nas valas dos bananais da baixada litoranea.** [*Rivulus santensis* as a Factor in the Control of Anopheline Larvae in Ditches in Banana Plantations on the coastal Lowlands.]—*Arq. Hig. Saúde públ.* **5** no. 10 pp. 125–127. São Paulo, 1940.

Observations in March-April 1933 in the Samaritá district of São Paulo showed that streams, lakes and flood water were free from Anopheline larvae, though many species occurred in ditches in the banana plantations. When the ditches were moderately full and contained fish (*Rivulus santensis*), there were no larvae, but when they were reduced to intermittent pools alternating with dry stretches, larvae were nearly always found in the smallest pools free from fish, and never in the larger pools containing fish. The ditches under observation were new, and had vertical sides, devoid of vegetation.

Laboratory observations showed that *Rivulus* fed readily on Anopheline larvae, and it is suggested that with a view to controlling Anopheline breeding in the plantations, a study should be made of the effect of deepening some of the ditches, so that the bottom is some 8–12 ins. below the outflow.

DE CARVALHO FRANCO (A.). **Os peixes larvófagos na luta contra a malária.** [Larvivorous Fish in Malaria Control Work.]—18 pp., 14 figs. São Paulo, Serv. Profil. Malár., 1940.

Fish are commonly used in Brazil for the control of *Aëdes aegypti*, L., but are not considered reliable against Anophelines, principally because Anopheline larvae and fish often occur together, though waters are frequently found to contain abundant fish and no larvae. Reasons for these differences are given. Whereas the usual Anopheline breeding places afford ample food for various forms of life and shelter from attack, the artificial breeding places of *Aëdes aegypti* do not. The latter can always be kept free of larvae by fish in sufficient numbers; control in the former by the same means increases in effectiveness as conditions become more artificial. Recommendations are given as to the most suitable kinds of fish. They should be small, strong and prolific and be surface feeders with larvae as their preferred food. Cyprinodontids and *Rivulus santensis* lend themselves to use in water of restricted area and depth, while Tetragonopterids are more suited to large collections of water. All are suitable for artificial containers, but *Rivulus* is the most resistant. Equipment and methods for use in catching and transporting fish for stocking breeding places and the rearing of fish are discussed.

UNTI (O.). **Anofelinos do vale do Rio Paraíba.** *Anopheles* (*Nyssorhynchus*) *strodei* **Root, 1926 com a descrição de tres variedades novas.** [Anophelines of the Paraïba Valley. *A. strodei*, with Descriptions of three new Varieties.]—18 pp., 8 figs., 22 refs. São Paulo, Serv. Profil. Malar. [1941.] (With Summaries in English and German.)

Anopheles strodei, Root, occurs throughout the Neotropical region at all seasons, at widely differing altitudes and in various breeding places and climates. In the Paraiba valley, the larvae were found in water rich or poor in organic matter, the concentration of consumed oxygen in breeding places varying from 0·00025 parts per mille in spring water to 0·005 parts per mille in polluted ditches and pools near dwellings. Dissolved oxygen varied from 0·0035 to 0·009 parts per mille. Larvae hatched from eggs placed in polluted waters with 0·0017–0·0019 parts dissolved oxygen per mille, but died within

24–48 hours. The presence or absence of iron, chlorides, calcium carbonate, ammoniacal nitrogen, nitrites, sulphates or bicarbonates in the water seemed to be unimportant. The pH of water in breeding places ranged from 4 to over 7. The habits of the adults vary considerably and are discussed with reference to the literature and the author's observations. In the Paraiba valley, where malaria does not occur, this species can always be caught with human or animal bait [*cf. R.A.E.*, B **33** 18], but in some other places in São Paulo State, it is mainly a sylvan species and is rarely attracted to domestic animals. References in the literature to natural and experimental infection of this species with malaria parasites in Brazil are reviewed [*cf.* **27** 228].

The eggs of *A. strodei* were first figured by Galvão & Lane [**25** 265]. Galvão later showed that it lays eggs of four types divisible into two main groups completely different in geometrical conformation and structure [**27** 227]; and Rozeboom observed similar variations in the eggs in Panama and classified them as types A, B and C [**26** 98]. Galvão & [Pereira] Barretto [**27** 227] found a further form, without floats. Rearing experiments with material from the Paraiba valley showed that four different types of eggs were constant from generation to generation. They are described and used to divide the species into four varieties, *viz.*, *A. strodei strodei* (*typicus*), with eggs corresponding to those figured by Galvão & Lane and included in Galvão's group I, *A. strodei* var. *arthuri*, n., with eggs like Galvão's group II, *A. strodei* var. *artigasi*, n., with eggs like Rozeboom's type A, and *A. strodei* var. *albertoi*, n., with eggs lacking floats. A further name is suggested for the form corresponding to Rozeboom's type C egg, should similar investigations show its characters to be constant. Adults reared from the various types of eggs did not show constant differences, but there was considerable variation both in the adults and in the chaetotaxy of the larvae. Because of this, *A. strodei ramosi*, Unti [**30** 147], which was described from the abdominal palmate hairs only, is not a valid variety.

Reid (J. A.). **A preliminary Note on Malayan Forms of** *Anopheles barbirostris*. —*J. Malaya Br. Brit. med. Ass.* **5** no. 2 pp. 71–72, 4 refs. Singapore, 1941.

Since *Anopheles barbirostris*, Wulp, was proved to be the vector of malaria in Batu Gajah [*R.A.E.*, B **25** 68 etc.], it has been generally considered a potentially important vector in Malaya, and infections in it have been reported in various years [*cf.* **26** 101; **27** 10; **28** 189] mainly from the Selangor coast. However, it was clear that it did not transmit the disease under all circumstances, as the surroundings of many of its breeding places are not malarious. Examination has now shown that there are two forms of the species in Malaya, but it is not known whether they correspond to the two distinguished by Venhuis in the Netherlands Indies [**28** 113]. The Malayan forms can at present be separated only in the adult stage. One has darker wings and more numerous pale scales on the under-surface of the abdomen than the other. The dark-winged form was found to be typically a mosquito of the coastal plains, but 11 of the 13 specimens of *A. barbirostris* in a collection from Batu Gajah, which is about thirty miles inland though less than 100 ft. above sea level, are of this form. Of 32 salivary gland infections found in 5,278 females of this species dissected at the Institute for Medical Research, 17 were in 3,697 specimens from coastal areas and the remainder in specimens from Batu Gajah. The light-winged form occurs both inland and on the coastal plain. No infection was found among some 1,200 females dissected from purely inland localities, excluding Batu Gajah. It is presumed that these females were light-winged.

In attempts to feed females on malaria patients, E. P. Hodgkin found that 60 per cent. of those of the dark-winged form and only 26 per cent. of those of the light-winged form, took blood. Records are given of some of the localities in which the dark-winged form has been found.

LANE (J.). **The geographic Distribution of Sabethini (Dipt., Culicidae).**—*Rev. Ent.* **14** fasc. 3 pp. 409–429, 9 maps, 27 refs. Rio de Janeiro, 1943. **The Zoogeography of Neotropical Anophelini (Diptera, Culicidae).**—*Op. cit.* **15** fasc. 3 pp. 262–268, 9 refs. 1944.

In the first paper, the faunistic subregions into which the Neotropical region has been divided by various workers are discussed, and definitions are given of the five centres of dispersal or endemism that the author has identified on the basis of present knowledge of the distribution of the Sabethine mosquitos [*cf. R.A.E.*, B **31** 96]. The centres are Central America, the Cariba or Guianan (the coast from Panama to the mouth of the Amazon), the Plateau (in central Brazil), Tupi (a coastal area with its centre at Rio de Janeiro), and the Incasic (the Pacific coast west of the Andes as far as the southern boundary of Peru). He also recognises two further subregions, the arid north-eastern portion of Brazil and Chile, from which Sabethines are absent, as they are also from Patagonia, because they are not adapted to desert or semi-desert conditions. The three paths that they probably take in dispersal from north to south or south to north are shown, and the distribution of the genera and subgenera is indicated.

It is stated in the second paper that the ANOPHELINI fit to a large extent into the centres of endemism and dispersal established for the SABETHINI. Lists are given of the species of *Anopheles* and *Chagasia* endemic or occurring in each centre and in an eighth, the Patagonic, which comprises middle and southern Argentina. The only centre negative for Anophelines was north-eastern Brazil. Theories regarding the distribution of *Chagasia* and the various subgenera of *Anopheles* in the Neotropical region are formulated, and the numbers of species of the tribes ANOPHELINI, MEGARHININI and SABETHINI present in the different centres are compared. It is believed that when the limits of most species are known, great progress will have been made towards knowledge of the real status of specific and subspecific concepts.

CORRÊA (R. R.), [DA] S[ILVA] RAMOS (A.) & G[UIMARÃES] RACHOU (R.). **Anofelismo e malária em algumas reprêsas do E. S. Paulo.** [Anophelines and Malaria in some Reservoirs in the State of São Paulo.]—*Folia clin. biol.* **15** fasc. 1 pp. 33–42, 10 refs. São Paulo, 1943.

Detailed data, compiled from official records, are given on the incidence of Anophelines and malaria near various reservoirs in the State of São Paulo, and regulations are quoted dealing with the situation, construction and maintenance of such reservoirs and designed to reduce the risk of malaria. Large expanses of water, both natural and artificial, have been found to be the preferred breeding places of *Anopheles darlingi*, Root, which is regarded as the chief indigenous vector of malaria in the plateau region [*cf. R.A.E.*, B **33** 21], and secondary vectors, such as *A. strodei*, Root, and *A. albitarsis*, Arrib., also develop readily in them. These were the species that occurred most frequently near the reservoirs. Only the first was found naturally infected with *Plasmodium* in the neighbourhood; on one occasion, A. L. Ayroza Galvão & S. J. Grieco dissected 105 females taken in dwellings and found seven gut and two gland infections, and at about the same time F. Fonseca, U. Bragança, E. Covelli & R. Zwicker found one infected female among 25 taken in dwellings. The house-frequenting character of *A. darlingi* was most marked.

[DA] FONSECA (J. A. B.) & UNTI (O.). **Infecção experimental de anofelinos de regiões indenes à malária.** [Experimental Infection of Anophelines from Regions free from Malaria.]—*Folia clin. biol.* **15** fasc. 1 pp. 43–52, 4 refs. São Paulo, 1943.

With a view to elucidating the cause of the absence of locally acquired malaria in the Paraíba Valley in the State of São Paulo, where Anophelines are

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plentiful, the species present [*cf. R.A.E.*, B **33** 18] are little different from those of the nearby malarious regions of the State, and infected persons enter from other areas in large numbers, tests were made on the possibility of infecting mosquitos from the valley. They were carried out between December 1940 and March 1942, at Guaratinguetá, in the valley, and at Guarujá, where malaria occurs. The material and technique used are described ; the results obtained in part of the work have already been noticed [**31** 142]. Gut and gland infections with *Plasmodium vivax* were obtained in *Anopheles albitarsis*, Arrib., *A. noroestensis*, Galvão & Lane, and *A. strodei*, Root, gland infection with *P. vivax* in *A. triannulatus*, Neiva & Pinto, and gut infection with *P. falciparum* in *A. albitarsis*. Data are given on the minimum times in which gut and gland infections developed. The infection rates obtained were sometimes high, and generally much higher at Guarujá than at Guaratinguetá ; the difference is attributed to the low infectivity of gametocyte carriers in the Paraíba Valley. This lower infectivity, the cause of which could not be determined, undoubtedly contributes to keeping the region free from malaria. As the Anophelines are susceptible to infection, sporadic cases of indigenous malaria may appear when gametocyte carriers with a high rate of infectivity enter the region.

Neal (P. A.). **DDT Toxicity. A Report on the Toxicity to warm-blooded Animals of Aerosols, Mists and Dusting Powders containing DDT.**—*Soap* **21** no. 1 pp. 99–101, 111, 2 refs. New York, N.Y., 1945.

The results are given of experiments on laboratory animals and man to appraise the risk involved in the use of DDT as an aerosol, mist or dusting powder. Exposure in such cases is principally by inhalation, though there is also some ingestion and skin contact. Important factors in exposure by inhalation are particle size, the concentration of the toxic agent in the air, duration of exposure, solubility, agglutination and settling rate. The experiments indicated that 1–5 per cent. DDT and 10 per cent. cyclohexanone in 89–85 per cent. Freon [dichlordifluoromethane] as an aerosol should be safe when used under the conditions required for insecticidal purposes. As solution of DDT in fatty oils increases its toxicity, solutions in cyclohexanone may be safer than solutions in oil. The use of DDT in concentrations up to 10 per cent. in inert powders for dusting clothes, as for the control of lice [*Pediculus humanus*, L.], does not appear to be dangerous, partly because the large particle size of the dust causes much of it to be retained in the uppermost sections of the respiratory tract. The remainder is swallowed, but on account of the relative insolubility of DDT, it is thought that only a small quantity is absorbed. Exposure for 48 minutes daily to a heavy mist of a mixture of 1 per cent. DDT in oil over a period of four weeks did not cause signs of DDT poisoning in rabbits, but irritation of the mucous membranes of the eyes, the upper respiratory tract and the skin was caused by the solvent. It is believed that the use of DDT as a fly-spray, involving only temporary and comparatively moderate exposure to much lower concentrations, should be safe. As DDT is toxic if ingested in large doses, it should not be used if there is any danger of heavy contamination of food. The experiments also showed that the contamination of the skin by the residues of the aerosol (containing all the constituents except Freon) left by a satisfactory insecticidal concentration in air is so slight that it will not cause injury to man. However, severe contamination of the skin with toxic effects may result from handling the materials, for instance in filling the aerosol containers, if due care is not taken, particularly if exposure is repeated.

Parkin (E. A.) & Green (A. A.). **Activation of Pyrethrins by Sesame Oil.**—*Nature* **154** no. 3896 pp. 16–17, 1 ref. London, 1944.

The experiments described show that the conclusions regarding the activation of pyrethrins in fly-sprays drawn by David & Bracey from their work on

Aëdes aegypti, L. [*R.A.E.*, B **33** 87] do not apply in the case of *Musca domestica*, L. The insecticide was atomised into a chamber in which the flies had been liberated, and they were removed after ten minutes' exposure to the mist. Records were made of the percentage knock-down during this period and the percentage kill after 24 hours. The sprays contained 0·05 per cent. w/v pyrethrins, and the adjuvants other than sesamin were used at 5 per cent. v/v. Sesamin was used at 0·05 per cent. w/v, a concentration corresponding to that in 5 per cent. of a satisfactory sample of sesame oil. Four samples of sesame oil (*TA*.3, *TA*.4, *TA*.43 and *TA*.44) were employed in the tests. It had previously been found that different samples vary markedly in the degree to which they activated pyrethrins, *TA*.3 slightly reducing both knock-down and kill. In a comparative experiment, the average percentage kills for the pyrethrins alone and with the addition of *TA*.3, oleic acid, medicinal paraffin and lubricating oil were 41·5, 35·2, 48·2, 30·6 and 36·2, respectively, indicating that adjuvants of low volatility do not as a rule increase the toxicity of pyrethrins to *M. domestica*. Those tested have little or no inherent toxicity at 5 per cent. In an experiment in which the quantity of spray applied was reduced, *TA*.3 and medicinal paraffin reduced the rate of knock-down, while *TA*.4 (which in earlier tests had caused marked increase in kill) and sesamin increased it slightly. Activation for kill was thus not dependent under these conditions on reduction of rate of knock-down.

In the first of three experiments on the effect of sesamin on kill, pyrethrins with *TA*.43 and desesaminised *TA*.43 gave kills of 72·9 and 53·6 per cent., respectively, the latter figure being higher than would be expected for pyrethrins alone. In another experiment, the kills effected by pyrethrins alone and with *TA*.44 and desesaminised *TA*.44 were 22·8, 48·0 and 29·7. The activating effect of sesamin was clearly demonstrated in an experiment in which the addition of it increased the kill from 36·6 to 72·8 per cent. The toxicity of *TA*.4 used alone in kerosene has been shown to be insufficient to account for the increase in kill by pyrethrins effected by it.

It is concluded that activation of the toxicity of pyrethrins to *M. domestica* by sesame oil depends mainly on the sesamin content of the oil, increase in kill being accompanied by a small increase in rate of knock-down. The inactive sample (*TA*. 3) gave a positive colour reaction for sesamin and optical measurements indicated an approximate sesamin content of 0·3 per cent. w/v as against the normal 1 per cent. In spite of the fact that this oil slightly reduced the toxicity of the spray and desesaminised oils, which gave a negative colour reaction, slightly increased it [*cf.* also **31** 8], there is no reason to doubt that the constituent of sesame oil chiefly responsible for activation is sesamin. It seems, however, that there may be present also a complex of secondary factors that, according to its composition, may increase or decrease the effect of pyrethrins or sesamin or both in a fly-spray.

Potts (W. H.). **Tsetse Hybrids.**—*Nature* **154** no. 3915 pp. 606–607, 2 refs. London, 1944.

Vanderplank (F. L.). **Hybridization between *Glossina* Species and suggested new Method for Control of certain Species of Tsetse.**—*T.c.* pp. 607–608, 2 refs.

In the first paper, a brief account is given of the results of experiments made in 1936 on the crossing of various species of *Glossina* with a view to using this as a method of control should they hybridise readily and produce sterile offspring. Attempts to cross *G. swynnertoni*, Aust., and *G. morsitans*, Westw., indicated that pairing was undertaken with greater reluctance than among individuals of the same species, very few offspring were produced and first-generation hybrids were fertile, though there was no evidence that those of the second generation were. In view of the discouraging results, the investigation was

abandoned. In other experiments with *G. swynnertoni*, *G. morsitans*, *G. pallidipes*, Aust., *G. palpalis*, R.-D., and *G. austeni*, Newst., in various combinations, no larvae were produced, though evidence of the insemination of females was obtained in each case. However, the numbers used were too small to exclude the possibility of success in these further crosses.

In the second paper, Vanderplank records more recent experiments, which showed that pairing between *G. swynnertoni* and *G. morsitans* when no choice was offered occurred as readily as between the two sexes of the same species, and also took place at random when there was a choice. The number of larvae produced per inseminated female living more than 21 days was 0·1 and 0·4 by females of *G. swynnertoni* and *G. morsitans* inseminated by the other species, and 2·4 and 4·0 by those inseminated by their own species. This poor production of first-generation hybrids is in itself a possible means of control. The average lengths of life of females inseminated by their own and other species were not significantly different. The male hybrids had distinct genitalia and showed affinities to the female parent. All the hybrids were similar to *G. swynnertoni* in external markings. No hybrids were obtained in experiments with *G. pallidipes*, both sexes of which were very reluctant to mate with either *G. morsitans* or *G. swynnertoni* and never did so when given the choice between them and their own species. A field experiment in which C. H. N. Jackson released 600 adults of *G. morsitans* from pupae in a *G. swynnertoni* area showed similar results to those obtained in the laboratory. The recaptured females were kept alive and the genitalia of their male offspring were examined. Attempts were made to cross both hybrids with each other and with *G. swynnertoni* and *G. morsitans*. The male hybrids inseminated the females, both hybrid and pure-bred, but there was no evidence of successful fertilisation. Attempts to cross female hybrids with pure-bred males of both species failed. The hybrid females, though produced in the laboratory, lived longer than their female parents. It was also observed that, a few hours after insemination, a female is no longer attractive to males and will not permit further coitus. A field-scale experiment on the extermination of *G. swynnertoni* by the release of large numbers of *G. morsitans* has been begun in Tanganyika in an isolated block with a scanty population of *G. swynnertoni*. It appears unlikely that *G. morsitans* can survive permanently in the area.

ETHERINGTON (D.). **Fertilization of** *A. maculipennis* **var.** *labranchiae* **in the Laboratory.**—*Nature* **154** no. 3915 p. 608, 1 ref. London, 1944.

No record is known of pairing of *Anopheles maculipennis* var. *labranchiae*, Flni., in a laboratory cage unless swarming has been induced by exposure to a blue light [*R.A.E.*, B **28** 85]. In experiments by the author, however, laboratory-reared adults that had emerged and were kept in a wire-mesh cage measuring 47 × 47 × 60 cm. laid viable eggs after ten days, though they had not been exposed to artificial light and no swarming had been observed. The cage was about 16 ft. from the window, and the end nearest the window was covered with a damp cloth. The females fed readily at any hour of the day on an arm introduced into the cage.

EWING (H. E.). **Notes on the Taxonomy of the Trombiculid Mites.**—*Proc. biol. Soc. Wash.* **57** pp. 101–104, 7 refs. Washington, D.C., 1944.

The author raises the TROMBICULINAE to the status of a family, erects two new genera and a new subfamily for the genus *Hemitrombicula*, and proposes a new generic name for one that is preoccupied. He also comments on Gater's record of *Trombicula akamushi*, Brumpt, from Malaya [*R.A.E.*, B **20** 179]. The identification was questioned by Womersley & Heaslip [**32** 161] although

they had not examined Gater's material. The author has examined five specimens, all taken by Gater from a single example of *Mus* (*Rattus*) *rattus falorensis* at the same time, and finds that they agree in all essential characters with *T. akamushi* from Japan, though they show considerable variation with regard to the relative lengths of the setae of the dorsal plate.

BOHART (R. M.) & FARNER (D. S.). **New Culicine Mosquitoes from the Philippine Islands (Diptera, Culicidae).**—*Proc. biol. Soc. Wash.* **57** pp. 69–72, 1 pl., 1 ref. Washington, D.C., 1944.

FARNER (D. S.) & BOHART (R. M.). **Three new Species of Australasian** *Aëdes* **(Diptera, Culicidae).**—*T.c.* pp. 117–121, 1 pl.

FARNER (D. S.) & BOHART (R. M.). **A preliminary Revision of the** *scutellaris* **Group of the Genus** *Aëdes.*—*U.S. nav. med. Bull.* **44** no. 1 pp. 37–53, 15 figs., 1 map, 32 refs. Washington, D.C., 1945.

FARNER (D. S.). **A new Species of** *Aëdes* **from the Caroline Islands (Diptera Culicidae).**—*Proc. biol. Soc. Wash.* **58** pp. 59–61. 1945.

STONE (A.) & FARNER (D. S.). **Further Notes on the** *Aëdes scutellaris* **Group (Diptera, Culicidae).**—*T.c.* pp. 155–161, 1 pl., 11 refs.

Armigeres apoensis, sp. n., and three new species of *Tripteroides* are described in the first paper.

The new species of *Aëdes* described in the second paper, all from adults of both sexes, belong to the *scutellaris* group. They are *A. guamensis* from Guam, *A. pernotatus* from the New Hebrides, and *A. quasiscutellaris* from the Solomon Islands. Examples of *A. quasiscutellaris* from the Solomons were described by Edwards [*R.A.E.*, B **14** 217], who provisionally considered them to be the typical form of *A. variegatus*, Dol., with *A. scutellaris*, Wlk., as a synonym. He later adopted the name *scutellaris* for *variegatus*, Dol., which is preoccupied [**21** 2]; the type localities are Amboina (*variegatus*) and the Aru Islands (*scutellaris*). The authors do not comment on the identity or otherwise of these two species, but consider that *quasiscutellaris* is not identical with either of them, since it appears to have a restricted distribution and has not been found in collections from eastern New Guinea, all mosquitos of the *scutellaris* group from New Guinea examined by them being *A. hebrideus*, Edw.

The third paper is a preliminary revision, based on adults only, of members of the *scutellaris* group occurring east of 140° east longitude. Careful consideration of the differences in the male genitalia has convinced the authors that the known Australasian members of the group, including *A. pseudoscutellaris*, Theo., *A. tongae*, Edw., *A. horrescens*, Edw., and *A. hebrideus*, which have been considered varieties of *scutellaris*, should be regarded as separate species. The occurrence of more than one in the same area (*e.g. A. pernotatus* and *A. hebrideus* in Espiritu Santo and Efate) lends support to this contention. A table is given for the identification of the known Australasian species of the group, *viz.*, *A. pseudoscutellaris* from Fiji, Samoa, Wallis, Ellice Islands, Cook Islands, Society Islands, Tuamotu and the Marquesas Islands, *A. tongae* from the Tonga Islands and, probably as a result of accidental introduction by man, from Sikiana (Solomon Islands), *A. horrescens* from Fiji, *A. pernotatus* from the New Hebrides, *A. hebrideus* from the New Hebrides and eastern New Guinea, *A. quasiscutellaris* from the Solomon Islands, *A. marshallensis*, Stone & Bohart, from the Marshall Islands, and *A. guamensis* from Guam. Their distribution is shown on a map, and records of each species in the literature and lists of areas from which specimens were examined by the authors are given, together with brief notes on biology. Epidemiological investigations in Espiritu Santo, the results of which have recently been published by R. H. Daggy, indicated that *A. hebrideus* is the vector of dengue there. *A. pseudoscutellaris* is known to transmit non-periodic filariasis [caused by *Filaria bancrofti*] in Fiji, the Ellice Islands and Samoa, and this, combined with the fact that its range

practically corresponds with that of the disease, which is endemic also in the Cook Islands, the Tokelau Group and Tuamotu, indicates that it is the important vector. Since, however, the disease also occurs in the Tonga Islands, where *A. tongae* is the only species of the *scutellaris* group known to be present, it is assumed that the latter is also a vector. The autochthonous filariasis [caused by *F. bancrofti*] in the New Hebrides and New Caledonia is, according to all reports, nocturnal.

The adults of both sexes and the fourth-instar larva of *A. hensilli*, sp. n., a member of the *scutellaris* group from the Caroline Islands, are described in the fourth paper.

It is stated in the last paper that examination of male mosquitos from the Philippine Islands showed that two species of the *scutellaris* group are present there. These are *A. hebrideus* and a species described from adults of both sexes as *A. paullusi*, sp. n., which occurs also in the Sangir Islands and possibly the Moluccas. It was reared in the Philippines from small pools of high organic content and water in coconut shells. The known range of *A. hebrideus* is also extended to the Palau Islands and Ceram, and that of *A. guamensis* to Saipan. A tentative key is given to the adults of the *scutellaris* group. The species included, in addition to those already mentioned in this series of abstracts, are *A. andrewsi*, Edw. (from Christmas Island, south of Java), *A. albopictus*, Skuse, and *A. gurneyi*, Stone & Bohart. The last two are not members of the group but resemble it morphologically and occur over some of its range. *A. alorensis*, Bonne-Wepster & Brug (from the Lesser Sunda Islands) and *A. scutellaris*, Wlk. (Aru Islands) are omitted from the key owing to the lack of adequate description. The distribution of the 13 species of the *scutellaris* group is summarised.

Byrd (E. E.), St. Amant (L. S.) & Bromberg (L.). **Studies on Filariasis in the Samoan Area.**—*U.S. nav. med. Bull.* **44** no. 1 pp. 1–20, 9 figs., 1 graph, 6 refs. Washington, D.C., 1945.

Filariasis caused by *Filaria* (*Wuchereria*) *bancrofti* is endemic among the natives of Samoa, 20–50 per cent. of whom have microfilariae in their blood. The stages of the filarial larvae in mosquitos are illustrated. The mosquitos that have been recognised in the area are *Aëdes pseudoscutellaris*, Theo., *A. aegypti*, L., *A. samoanus*, Grünb., *A. vexans*, Mg., *Culex fatigans*, Wied. (*quinquefasciatus*, auct.), *C. annulirostris*, Skuse, and *C. sitiens*, Wied. *A. pseudoscutellaris* is the most abundant, and the principal night-feeding species are *A. samoanus* and *C. fatigans*, the former being the more widely distributed and the more important in most districts. In investigations made between April 1943 and February 1944, some females of *A. aegypti* and *C. annulirostris* were infected with *F. bancrofti* experimentally, but no larvae were found in any dissected more than seven days after the infective meal, whereas about 14 days are necessary for development to the infective stage. None of the females of *A. aegypti* lived more than ten days. Experimental infection was brought about by a single infective blood-meal in 29 per cent. of females of *C. fatigans*, and in more than 80 per cent. of those of *A. pseudoscutellaris*. More than 80 per cent. of the latter that survived at least 15 days following the infective meal carried infective-stage larvae. Of more than 20 females of the former that survived as long, only one harboured an infective-stage larva, but of eight that died on the 12th day, six carried developing larvae. Natural infections were found in 9·9 per cent. of the females of *A. pseudoscutellaris* dissected and in 7·4 per cent. of those of *C. fatigans*, but no larva more than seven days old was found in a naturally infected female of *C. fatigans*. Many of the females of *A. pseudoscutellaris* carried two or three stages of the parasite, and more than 15 per cent. of those found infected harboured the infective-stage larvae. Both species took at least three blood-meals in 14 days.

It is believed that *A. pseudoscutellaris* is alone responsible for transmission in the Samoan area. It breeds extensively in dense jungle as well as near dwellings, particularly in very small quantities of water that collect in coconut shells, tins, tree holes and similar places, and only rarely in ground puddles. The females feed throughout the daylight hours even in strong sunlight, but most actively in dense shade at dawn and dusk. They rest in grass and low vegetation, under houses and in other places near the ground and protected from wind and strong light. The flight range is very short. Often 25 per cent. or more of females from the centre of a native village are infected, while at 25 and 50 yards from the periphery, the rate falls to 20 and 4–5 per cent., respectively, and only an occasional infected female is found 100 yards or more away. Practically no infected mosquitos were found to the windward side of a village. Eradication of the mosquito is possible only on small atolls, but an effective control programme in villages and camps can reduce breeding so as to maintain the population at a very low level.

To protect troops from filariasis transmitted by *A. pseudoscutellaris*, camps should be at least 500 yards from the nearest native dwelling, or to the windward side of a native concentration if they cannot be isolated from it, natives should not be allowed to enter camps and, where working parties are essential, only natives showing no microfilariae in the blood stream should be employed. Troops should not be allowed to enter native villages during daylight, or if obliged to do so should be fully dressed and protected by efficient mosquito repellents. Quarters should be screened and bed nets used, and mosquito breeding places and grass and other resting places should be destroyed for 100 yards beyond the periphery of the occupied area.

Schwetz (J.). **Sur les moustiques du cours inférieur de la rivière Lomami (Congo belge).**—*Rev. Zool. Bot. afr.* **35** fasc. 3–4 pp. 323–327, 2 refs. Brussels, 1942.

Lists are given of the mosquitos collected as adults and as larvae in equatorial forest along the lower course of the Lomami River in the Belgian Congo in 1928 [*R.A.E.*, B **19** 105] and at a point on the river some 12 miles from Isangi in June 1939. In all, 37 species were found. The additional ones recorded in 1939 included two species of *Anopheles*, *A. funestus*, Giles, and *A. moucheti*, Evans, both of which were rare and were not taken as larvae.

Wanson (M.) & Lebied (B.). **Un nouvel anophèle cavernicole du Congo belge, *Anopheles* (*Myzomyia*) *vanhoofi* spec. nov.**—*Rev. Zool. Bot. afr.* **39** fasc. 1 pp. 118–129, 19 figs., 3 refs. Brussels, 1945.

Descriptions are given of the larva, pupa and reared adults of both sexes of *Anopheles* (*Myzomyia*) *vanhoofi*, sp. n., two females and immature stages of which were taken on 8th October 1945 in a large cave at Thysville in the Belgian Congo. The larvae and pupae occurred in rock pools formed by water dripping from the roof in a completely dark chamber about 1,000 feet from the entrance of the cave. The water was clear and had a temperature of 22°C. [71·6°F.] and a pH of 6·5–7. The females presumably feed on bats, which abound in the chamber. Attempts to induce them to suck human blood failed. Adults of *A. moucheti*, Evans, *A. coustani*, Lav., and two species of *Culex* were taken at the mouth of the cave.

Leví Castillo (R.). **Los anofelinos de la República del Ecuador. Tomo primero.** —$8\frac{1}{2} \times 5\frac{3}{4}$ ins., [11 +] 172 pp., 45 pls. (15 fldg.), 5 fldg. maps, 12 pp. refs. Guayaquil, Artes Graficas Senefelder C. A. Ltda., 1945.

Apart from a short introductory section on the position, topography and climate of Ecuador, the information in this volume consists of data on the

morphology, ecology, breeding places and distribution within the country of the Anophelines known from the author's personal observations to occur there. These are *Chagasia bathanus*, Dyar, *Anopheles pseudopunctipennis*, Theo. (represented by two varieties), *A. eiseni*, Coq., *A. punctimacula*, D. & K., *A. apicimacula*, D. & K., *A. mediopunctatus*, Theo., *A. albimanus*, Wied., *A. aquasalis*, Curry, *A. neivai*, H., D. & K., and *A. boliviensis*, Theo. An English summary concludes the discussion of each. Lists are given of those occurring in the various provinces, as well as keys to the males (based on genitalia) and females of the species and two varieties, the eggs of eight of them and the larvae of the species, and figures of the main diagnostic characters.

The two varieties by which *A. pseudopunctipennis* is now stated to be represented in Ecuador are *levicastilloi*, Leví Castillo [*cf. R.A.E.*, B **33** 156] and one here described as *rivadeneirai*. The females can easily be distinguished by their colour and size, those of the former being much smaller, and the eggs are quite distinct from each other and from those of the typical variety described by Rozeboom [**26** 40]. *A. p. levicastilloi* occurs in the five provinces of the coastal region up to an average altitude of 1,000 ft. above sea-level. It is zoophilous and has never been found infected with malaria parasites in nature or taken in houses, but has been infected in the laboratory. It breeds in sunlit marsh pools containing aquatic plants and having a temperature of 25–27°C. [77–80·6°F.] and a pH of 8·3–9. The larvae come to the surface for only 10–15 seconds at a time, then submerge for 22–40 seconds to feed. *A. p. rivadeneirai* is found at altitudes up to at least 8,000 ft. in nine provinces of the interandine or sierra region [including the seven in which the typical form was previously stated to occur and transmit malaria (**33** 156)], and has been carried into the coastal region by a railway. It is essentially anthropophilous and is the main vector of malaria in the warm highland valleys, where it breeds principally in sunlit rock pools with a temperature of 18–23°C. [64·4–73·4°F.], a pH of 7·5–8·5 and abundant *Spirogyra*. These pools are left when the river level falls after flood. The females are fertilised immediately on emergence. Attempts to rear this variety at sea-level failed. The chief malaria vector in the five coastal provinces is *A. albimanus*, Wied., which is very abundant at altitudes not exceeding 150 ft. It sometimes had an infection rate of 3–5 per cent. Its usual breeding places are fresh-water sunlit pools, clean or dirty, with a temperature of 20–25°C. [68–77°F.] and a pH of 6·5–8·5. They are generally near dark places in which the adults seek shelter on emergence. Larvae were also found in leaves of plantains and in coconut husks and may occur in any deposit of water where there is sun and sufficient food. The author has reared this species in captivity. The females died immediately after oviposition, but if unfed they survived for two weeks and laid infertile eggs. They enter houses to feed only if attracted by light. It is suggested that control in some breeding places may be effected by admitting sea water. *A. boliviensis*, which breeds in epiphytic Bromeliads, is suspected of carrying malaria in the Amazonian region on account of its liking for human blood and human dwellings, but it has never been found infected in nature. It has a restricted flight range.

It is proposed to publish further volumes as more species are studied.

[Gutzevich (A. V.).] **Гуцевич (А. В.). On the Distribution and Biology of *Anopheles maculipennis* Mgn. in Transbaikal Region (USSR).** [*In Russian.*] —*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **19** pp. 25–34, 3 figs., 9 refs. Leningrad, 1939. (With a Summary in English.)

The only Anopheline found during a survey in eight districts in the western, central and south-eastern parts of Transbaikalia in the summer of 1936 was *Anopheles maculipennis*, Mg., and all the eggs taken in the field or laid in the laboratory belonged to var. *messeae*, Flni. The distribution of the mosquito was irregular and it is thought to be absent from the mountains and the vast areas

of primeval forest. It was commonest along the river valleys and near villages, but did not occur in a health resort situated in a pine forest at an altitude of over 3,000 ft., probably because of the low temperature of the water in potential breeding places, which varied from 0 to 9·5°C. [32–49·1°F.].

The chief breeding places were formed by the flooding of the rivers, especially if the water had various plants growing out of it and reeds at the edges, but the larvae also occurred in small pools in the beds of streams that dried up in summer, millponds, borrow-pits, and small swamps near springs. They were not found in rivers or streams with a rapid current or in water with a temperature of less than 12°C. [53·6°F]. Other mosquito larvae that occurred together with them were *Aëdes vexans*, Mg., and *Culex modestus*, Fic., which was rare. Observations on the seasonal occurrence of larvae and adults, showed that at least two generations are produced during the year ; the adults of the first began to emerge on 21st June, and those of the second at the end of July. The mosquitos were active until mid-September, when the females presumably entered hibernation, and it is possible that a third generation may develop under favourable conditions, the adults emerging about the end of August.

The females attacked man readily in houses and very occasionally in the open, but were most common in sheds in which domestic animals were kept and scarce in houses if such sheds were near them.

The overwintered females are of little importance in the transmission of malaria, as malaria parasites in them cannot survive the cold winter or develop rapidly at the low temperatures prevalent in May and the first half of June. Almost all primary infections occur during July–September.

[Gutzevich (A. V.).] **Гуцевич (А. В.). On the Blood-sucking Diptera in Transbaikal Region (East Siberia).** [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **19** pp. 35–47, 4 figs., 8 refs. Leningrad, 1939. (With a Summary in English.)

A survey of blood-sucking Diptera, similar to one already noticed [*R.A.E.*, B **33** 185], was carried out in June–August 1936 in nine localities in the Province of Chita and the Buryat-Mongol Republic, and the results are shown in tables and discussed. Of the 4,000 examples obtained, about 2,500 were taken on man ; these comprised 15 Tabanids, 13 mosquitos, five Ceratopogonids and three Simuliids, and mosquitos and Simuliids constituted 69 and 28 per cent., respectively, of the total.

The mosquitos occurred mainly in the open, and *Aëdes vexans*, Mg., was much the most common and troublesome ; *Anopheles maculipennis*, Mg., which was the only Anopheline, was the most abundant of all the Diptera in buildings. The Simuliids taken on man were almost exclusively *Simulium cholodkowskii*, Rubtzov, with small numbers of *S. decimatum*, Rubtzov, and *S. transiens*, Rubtzov. The first two species bred in the river Onon, and empty pupal cases were found on 19th and 24th June, respectively. The temperature of the water in which *S. cholodkowskii* bred in numbers was 17°C. [62·6°F.] and the current 26 ins. per sec. ; mass flights of adults of this species were observed between 21st June and 23rd July, and some were taken on a hill six miles from their breeding place. The Tabanids caused little annoyance to man but attacked domestic animals severely ; the most numerous were *Tabanus montanus*, Mg., *T. fulvicornis*, Mg., *T. astur*, Erichson, and *Haematopota* (*Chrysozona*) *turkestanica*, Kröber. Ceratopogonids were scarce in the steppe, but rather active in the mountain-forest zone ; *Culicoides pulicaris*, L., was the commonest, the other species taken on man being *C. nubeculosus*, Mg., and *C. impunctatus*, Goetgh.

Field tests confirmed the value of pyrethrum smoke-candles in reducing attack by blood-sucking Diptera [*cf. loc. cit.*] and showed that candles in which the pyrethrum powder was replaced by tobacco dust were equally effective.

[Stukolkina (N. N.).] **Стуколкина (Н. Н.). Studies on the Biology of Black-flies in Transbaikalia.** [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **19** pp. 49–60, 3 figs., 2 refs. Leningrad, 1939. (With a Summary in English.)

A detailed account is given of observations on the bionomics and larval ecology of Simuliids carried out in the summer of 1936 in the central part of the Buryat-Mongol Republic east of Lake Baikal, the results of which confirmed the findings of Rubtzov in an area west of the lake [*cf. R.A.E.*, B **25** 56]. The character of the stream and the two rivers in which the larvae were found is described, with special reference to the rapidity of the current and the variations in water temperature. Of the 20 species recorded, 15 bred in the stream, in which the water was clear and had a temperature that varied from below 3°C. [37·4°F.] at the source to 20°C. [68°F.] or higher at the mouth, while the others occurred in the rivers, both of which were muddy. The lowest temperature at which the larvae were numerous was 3°C., which is apparently the threshold of development of the species that thrive in cold water. The distribution of the different species from the source to the mouth of the stream and the character of their habitats are discussed, as well as the seasonal occurrence of the individual species and the duration of the various stages of development, which is represented graphically for typical species that produce one, two or three generations a year.

[Rubtzov (I. A.).] **Рубцов (И. А.). Remedies against Black-flies and Mosquitoes.** [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **19** pp. 61–74, 1 fig., 20 refs. Leningrad, 1939. (With a Summary in English.)

Methods of obtaining protection from mosquitos and Simuliids were studied by the author in areas west and east of Lake Baikal. Good protection was afforded by pyrethrum candles [*cf. R.A.E.*, B **23** 291], but in view of shortage of pyrethrum, attempts were made to find a local wild plant that would give off a repellent smoke when twisted into sticks, partly dried and burnt. *Mentha arvensis*, *Nepeta lavandulacea*, and several species of *Artemisia* proved unsuitable, but sticks made of thyme (*Thymus serpyllum*), tied spirally with thick cotton and dried in the air for a week were about as effective as pyrethrum candles and required no potassium nitrate to make them burn. When lit, they smouldered evenly to the end, sticks about ½ in. thick and 6 ins. long lasting for 1½ hours, or three times as long as a pyrethrum candle of the same size. Counts showed that the numbers of insects alighting on persons bearing them were only 10–15 per cent. of those on unprotected persons.

In field tests in which about 30 substances alone or in combinations were applied to the human skin as repellents, cinnamon oil remained effective for about 24 hours, but none was entirely satisfactory. Horses are commonly protected by smearing the susceptible parts once or twice a day with tar oil, but too frequent applications are injurious. The injury was avoided by using a mixture of tar oil, kerosene and water similar to that recommended by Cameron [**10** 182].

[Rubtzov (I. A.).] **Рубцов (И. А.). Factors of Outbreaks of the Black-flies.** [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **19** pp. 177–207, 7 figs., 31 refs. Leningrad, 1939. (With a Summary in English.)

Simuliids occur in enormous numbers in many parts of the vast area that extends from the Yenisei to the eastern coast of Asia, and a detailed survey, based on the literature and investigations by the author in 1936, is given of the factors that favour their mass propagation. The outbreak regions are more or

less confined to the zone of primeval forest, the heaviest and most regular outbreaks take place in the mountain districts, and the flies are particularly abundant in the region of Lake Baikal and the system of the river Lena. Of the many species present, *Simulium decimatum*, Dorog., Rubtz. & Nasenko, is the most abundant west of Lake Baikal, *S. cholodkowskii*, Rubtzov, in Transbaikalia, *S. maculatum*, Mg., in the Lena forest and the Russian Far East, and *S. venustum* var. *kamtschaticum*, Rubtzov, in Kamchatka.

The factors that affect the ability of particular species to increase to outbreak numbers include the number of generations a year, and, particularly, adaptability to environment. The duration of a generation depends primarily on the temperature of the water in which the larvae develop [*cf. R.A.E.*, B **25** 56], since the egg and pupal stages last only 10–12 and 7–10 days in species that produce one generation a year and 5–8 and 4–6 in those that produce more, and the adults do not survive longer than three weeks. Species that thrive in cold mountain streams in which the mean summer temperature is 8–10°C. [46·4–50°F.] produce only one generation a year, the larval stage lasting 9–10 months. Most of the species, however, give rise to two generations a year, with larval stages lasting about one and 8–9 months. The species that produce three breed in streams in which the temperature is 18–20°C. [64·4–68°F.] in summer, the larval stage lasting 7–8 months in the winter generation and 20–30 days in the others. In all the species studied the sex ratio was about 1 : 1, and the average number of eggs laid by a single female was about the same. The maximum number laid by females of species that produce two generations a year varied from 160 to 240, but the actual average maximum fertility in a population was only 70–100 eggs per pair of flies, since most of the females do not mature their eggs, owing to failure to obtain a blood-meal or to unfavourable weather.

The larval stage is the one most susceptible to deviations of the environment from the average. The threshold of development is about 3°C. [37·4°F.] for the species that thrive in cold water and about 4–6°C. [39·2–42·8°F.] for those that live in warmer waters. The zone of cold torpor lies between 0 and −2°C. [32–28·4°F.], and the zone of normal larval activity in the various species at temperatures between 4 and 25°C. [77°F.]. The upper limits are not clearly defined and vary with the species, beginning at 15, 25 or 30°C. [59, 77 or 86°F.], torpor and death occurring between 30 and 40°C. [104°F.]. The larvae can develop normally in water flowing at rates of about 0·5–4·3 ft. per second. The water must have a very high oxygen content and a low content of carbon dioxide ; with a decrease in oxygen content to below 90 per cent. of saturation, the abundance of the larvae falls off rapidly and only single individuals occur in water that is only 70–80 per cent. saturated. They survive, however, though they do not develop, in water in which this percentage is only 40–50. Fluctuations in the pH of the water from 6·5 to 9 have no effect on the larvae, and they are very resistant to the presence of various salts. They are fairly indiscriminate feeders and swallow any detritus or plankton that is available.

The pupae occur only in the warm season and develop in a short period so that they are scarcely affected by changes in temperature. They withstand considerable fluctuations in the oxygen content of the water and can complete their development out of water, provided that there is sufficient atmospheric humidity. Thus, most of them give rise to adults even when the level of the water falls so that they become exposed. They soon die, however, in muddy water, in which suspended particles of detritus block the respiratory system. Constant humidity is necessary for the eggs ; none survived when left without water for 6–8 hours. Activity of the adults was normal at temperatures between 10 and 29°C. [50–84·2°F.], with the optimum at about 20–23°C. [68–73·4°F.] and a relative humidity of 75–90 per cent. This humidity occurs in the field by day only in forests and along river banks covered with shrubs. Daylight is essential for adult activity, which is favoured by dull cloudy

weather [*cf.* **25** 57], and the absence of rain and high wind. A female feeds and oviposits only once, the blood-meal being essential for the maturation of the eggs.

A comparison of data on 23 species of Simuliids that occur in the region shows that there is a direct correlation between the abundance of a species and its ecological adaptability, and this factor is also of prime importance in its effect on the ability of a species to spread over large areas. The ways in which such distribution is limited are discussed at length, and it is shown that scarcity of food for the adults may inhibit oviposition. The larvae cannot survive in streams that are frozen to the bottom, and high temperatures lower their resistance to diseases. Predators, parasites and diseases are of less importance for the adults than for the larvae, which are destroyed by fish, aquatic birds, and the larvae of certain insects, particularly Trichoptera, parasitised by Protozoa and killed by fungous and other diseases.

Ewing (H. E.). **The Trombiculid Mites (Chigger Mites) and their Relation to Disease.**—*J. Parasit.* **30** no. 6 pp. 339–365, 8 figs., 5 pp. refs. Lancaster, Pa., 1944.

The life-history of Trombiculid mites is outlined, data on the life-cycle of *Eutrombicula alfreddugèsi*, Oudm., and the history of the classification of the family are briefly reviewed, and a key is given to the genera. Trombiculids are reported from all the zoogeographical regions of the world and are found in greatest abundance and diversity in areas with a hot, moist climate and a abundance of vertebrate life. The distribution of *E. alfreddugèsi*, *Trombicula autumnalis*, Shaw, *T. akamushi*, Brumpt, and *T. deliensis*, Walch, which are the best known species, is considered in some detail. An account of the way in which infestation by the larval mites sets up irritation is followed by brief reviews of the relationship of Trombiculids to tsutsugamushi disease, and of measures that have been employed against them with successful or promising results. These include destroying them by applying sulphur or DDT in the field [*R.A.E.*, B **32** 200], modifying the ecological factors in their environment by such means as the destruction of shrubs or larger herbaceous plants, the removal of litter or the use of infested fields as pasture, and protecting man from attack by the impregnation of clothing with repellents [**14** 28 ; **33** 21] and the use of repellents on the skin and of closely woven mite-proof garments. The danger of spreading tsutsugamushi disease because of war conditions is discussed. Its establishment in new countries is considered unlikely, though it might be introduced by infected soldiers, by infected mites carried on man or in soil or produce of various kinds, or by reservoir hosts, notably rats. Its transmission, however, would require the establishment of a vector or the adaptation of the rickettsiae to an indigenous mite. In conclusion, a list is given of aspects of the study of Trombiculids of which investigation is needed.

Bushland (R. C.), McAlister jr. (L. C.), Eddy (G. W.), Jones (H. A.) & Knipling (E. F.). **Development of a Powder Treatment for the Control of Lice attacking Man.**—*J. Parasit.* **30** no. 6 pp. 377–387, 3 figs., 10 refs. Lancaster, Pa., 1944.

An account is given of tests begun in Florida in 1942 to find a powder, non-toxic to man when in prolonged contact with the body, that would destroy *Pediculus humanus humanus*, L. (*P. h. corporis*, Deg.) and remain effective for several days. A brief summary of the results has been noticed [*R.A.E.*, B **33** 106]. The lice were reared in a manner already described [**33** 161], and those used in laboratory tests were recently-fed young adults. To select effective materials, small pieces of cloth were immersed in 1 per cent. solutions of test substances, dried at room temperature for two hours and placed in

beakers with ten lice. If the lice were dead 24 hours later, more were added at intervals to determine the duration of effectiveness. Compounds thus found toxic were deposited on pyrophyllite from an acetone solution to form powders containing 5 per cent. test material and these were tested by the " arm-and-leg " method [**33** 109]. If the lice died, infestation was repeated at intervals of one or two days until some survived. If the duration of effectiveness of a treatment did not exceed the incubation period, the incorporation of an ovicide was desirable. Powders were tested as ovicides by shaking a pad bearing 200 eggs in a small bag with a little of the dust for about a minute and then removing the pad and keeping it at 30°C. [86°F.] and about 85 per cent. relative humidity. The ovicidal effect of a powder being tested by the arm-and-leg method could also be estimated by including a pad bearing eggs. Materials that had shown promise in the laboratory were tried on men artificially infested with large numbers of lice and eggs and domiciled in a dormitory until the desired data were obtained. Powders were applied at 30 gm. per suit of underwear, and socks, outer clothing and bedding were not dusted. The effect of treatment was examined daily. In the case of effective materials, the subjects were reinfested after two days and weekly thereafter until the treatment became ineffective. The garments were worn continuously during the tests.

Only a quarter of the several hundred synthetic compounds tested by the beaker method were lethal, and only about one-third of these were lethal when tested by the arm-and-leg method and then only for a short time. Powders containing pyrethrum and derris extracts appeared more promising for immediate use than synthetic organic compounds [but *cf.* **32** 197]. They were comparable in effectiveness, but the pyrethrins killed the lice more quickly, and rotenone caused severe scrotal dermatitis in about two-thirds of the subjects. Pyrethrum extract was therefore chosen, and as the supply was limited, over 200 materials were tested by the arm-and-leg method as synergists for it in pyrophyllite powder. Many were very effective against lice, and N-isobutylundecyleneamide (IN–930) was outstanding [**33** 109]. Because pyrethrum powders deteriorate with storage, several antioxidants were tried, and some enabled powders containing pyrethrum extract to be exposed to air in a thin layer for almost three months without deteriorating, whereas a control powder ceased to kill lice within 44 days. Phenol S (essentially isopropyl cresols obtained as a by-product of thymol manufacture) was selected. A powder containing 0·25 per cent. of it appeared to be as effective after exposure to the air in a thin layer for six months as it was when fresh, and did not show deterioration when exposed for a month at 140°F., though after two months at this temperature it was less effective than a fresh powder. The combination of pyrethrum extract, synergist and antioxidant was not ovicidal and the period of protection to be expected was not as long as the egg stage. Ovicides were therefore tested, and one of the most effective was 2,4-dinitroanisole, which at 5 per cent. in a dust was lethal to eggs at relative humidities above 70 per cent. It was, however, almost ineffective at much lower relative humidities [**33** 172–173]. Its ovicidal effect was increased by IN–930, and 2 per cent. of each in a powder at favourable humidities killed eggs in all stages of development up to within at least one day of hatching. It killed lice also.

After extensive tests, the powder designated MYL and containing 0·2 per cent. pyrethrins (from a 20 per cent. concentrate), 2 per cent. N-isobutylundecyleneamide, 2 per cent. 2,4-dinitroanisole and 0·25 per cent. Phenol S, in pyrophyllite to make 100 per cent., was recommended to the armed forces. Commercial lots were prepared by dissolving the pyrethrum concentrate, synergist and antioxidant in alcohol denatured with acetone, spraying the solution into the pyrophyllite and mixing in the finely ground ovicide. Biological tests indicated that this method was generally satisfactory. MYL has since been repeatedly tested and found to give at least a week's protection. In cool weather, it was often effective for 10–12 days. It was found superior to a

powder containing 10 per cent. lauryl thiocyanate and one (AL–63) containing derris extract. Hungry lice exposed to it for only 10 minutes were unable to feed, and all the lice were knocked down or immobilised by exposure for 15 minutes. With freshly fed lice, about half were killed in six hours, and all in ten.

All motile forms of *Phthirus pubis*, L., were killed when all hairy parts of the body were dusted with MYL and the powder was not removed by washing until the following day. Destruction of all eggs was not assured, but eradication was effected by a single treatment in many cases. A second application after 8–10 days is recommended. All motile forms of *P. humanus capitis*, Deg. (*P. h. humanus*, auct.) were destroyed when five infested persons were treated, but a few newly hatched nymphs were found later on three whose hair was washed 1, 2 and 4 days after treatment. The other two whose hair was not washed for at least 10 days remained free of lice. A second application 10–14 days after the first is recommended. The active ingredients of MYL applied in a liquid formula were effective at lower concentrations than in the powder. MYL powder has been used successfully against ants, fleas and bed-bugs [*Cimex*].

Schoen (C.). **Gesarol tegen vliegen in veestallen.** [Gesarol against Flies in Cattle Sheds.]—*Tijdschr. PlZiekt.* **50** no. 3 pp. 69–71. Wageningen, 1944.

Gesarol preparations [of DDT] are being tested in Holland against various insects that are pests in houses and cattle sheds, and the directions issued by the importers for the use of Gesarol and Gesarol M in the latter are reproduced and briefly discussed. It is recommended that either material be applied in a 1 per cent. spray to walls and other surfaces so that a deposit of 2 gm. per sq. metre is obtained, and it is claimed that this remains effective for 3–6 weeks. In tests in cattle sheds, good results against *Stomoxys calcitrans*, L., were obtained in 20 minutes at a temperature of 70°F. when Gesarol was applied at 0·5 gm. per sq. metre, but the residue was effective for less than a month, which may have been due to the reduced deposit. Its effect was less rapid at lower temperatures. Gesarol M is specially designed for use in cattle sheds, but Gesarol is also satisfactory. Gesarol dusts are less effective for this purpose.

In investigations on the effect of Gesarol on warm-blooded animals, it showed no toxicity when placed on the skin, injected beneath the skin or introduced into the respiratory system of rats or when ingested by dogs, all in amounts far greater than would be met with in practice.

Emmel (M. W.). **The Primary Screw-worm Fly, *Cochliomyia americana* C. and P., as a Vector of Joint Ill in Calves.**—*J. Amer. vet. med. Ass.* **106** no. 817 p. 223. Chicago, Ill., 1945.

Joint ill or swollen joints [pyaemic arthritis], which had previously been almost unknown among beef calves in Florida, began to appear when *Cochliomyia hominivorax*, Coq. (*americana*, Cush. & Patt.) was introduced into the State some ten years ago. It assumed serious proportions in 1944 when almost every section of Florida was involved, and loss of 5 per cent. of calves was not uncommon. In one instance 70 out of 300 calves died. This increased incidence coincided with an increase in the prevalence of *C. hominivorax* owing to a mild winter and shortage of labour. Cultures were made from the contents of the joint capsules of 16 calves on eight widely separated ranges, and *Streptococcus pyogenes* was isolated in pure culture from the affected joints of three animals and also from the unhealed *Cochliomyia*-infested navel of one. The remaining capsules were sterile. The micro-organism was never isolated when the joint capsule contained inspissated pus or when the contents of the capsule did not

contain pus although the affected joint was markedly enlarged. It appears that pus never forms in the joint capsule of some animals, but intense inflammation of the surrounding tissues results in hardness, swelling and lameness. Various leg joints may be affected, but more than one joint is seldom involved on the same animal. Joint ill developed when the calves were under four weeks old. Some 75–90 per cent. of the affected animals died from septicaemia 2–4 weeks later. Those that recovered usually had a permanently enlarged or deformed joint. Infestation of the navel by *C. hominivorax* had generally occurred in calves that developed swollen joints. Infection of the navel of calves less than two weeks old with *S. pyogenes* resulted in the development of swollen joints within 8-14 days. Smear 62 [a dressing in which the main ingredients are diphenylamine and benzene (*cf. R.A.E.*, B **30** 195)], which is the preparation generally used under range conditions in Florida for the control of *C. hominivorax*, did not disinfect a navel experimentally infected with *S. pyogenes*. *C. hominivorax* was shown to be able to carry *S. pyogenes* from an infected navel to an uninfected one with the subsequent development of joint ill. It is assumed that the newly-hatched larvae carry the bacteria to the deepest recesses of the wound, where their activities probably greatly enhance the likelihood of infection. The prompt treatment of unhealed navels with tincture of iodine and a reliable repellent against *C. hominivorax*, and the persistent care of the wounds until completely healed are considered essential measures against outbreaks of joint ill.

Gould (G. E.). **Roach Control Tests.**—*Soap* **21** no. 2 pp. 113–115, 121, 15 refs. New York, N.Y., 1945.

Data published by various workers in 1943 and 1944 on the control of cockroaches, chiefly with DDT, are reviewed [*R.A.E.*, B **31** 228 ; **32** 123, 196, 205, 206 ; **33** 73], and the results are given of tests made by the author against the German cockroach [*Blattella germanica*, L.] since his last publications on the subject [**32** 74, 156]. They were made in a dust settling chamber as in the earlier work [*cf.* **32** 74, etc.]. Commercial sodium fluoride was inferior to a finely ground sample, and nile-blue samples were somewhat better than white ones from the same firm. A comparison of 11 common diluents for sodium fluosilicate, with which they were mixed in equal parts, indicated that none was outstandingly better than the others, but bentonite was definitely inferior. Boric acid was again more lethal than borax, and mortality counts after ten days showed much higher toxicity than was observed after four days in the earlier work [**32** 74]. A mixture of equal parts of boric acid and pyrethrum marc was rather more effective than boric acid alone. The inclusion of 25 per cent. pyrethrum marc in a 10 per cent. mixture of dinitroanisole in pyrophyllite increased kill of females from 71 to 93 per cent. All mixtures of dinitroanisole and marc killed all males, but only one (5 per cent. dinitroanisole, 50 per cent. marc and 45 per cent. boric acid) killed all females. Orthonitroanisole at 4 per cent. in marc or pyrophyllite gave poor results, and 10 per cent. in marc killed all males but only 18 per cent. of females. DDT gave good results at 10 and 25 per cent., as did Gesarol A20, a commercial spray powder containing 20 per cent. DDT ; Gesarol A3 (containing 3 per cent. DDT) knocked down the cockroaches in 12 hours or less, but many were still kicking after 96 hours. Two louse powders thought to be samples of MYL, which contains pyrethrum extract and dinitroanisole [*cf.* **34** 45] gave complete mortality of both sexes, as did also a thiocyanate preparation, Lethane A70 [*cf.* **33** 97], which was quicker in action than sodium fluoride or pyrethrum in the laboratory, but is irritant to the operator and has failed to eradicate some infestations in practice, probably because of repellent action. N-H roach powder, which contains pyrethrum marc and a nitrated hydrocarbon, killed all males and 97 per cent. of females. A mixture of equal parts of a phenothioxin and bentonite was comparatively poor, and though a powder containing 5 per cent.

dimethyl phthalate gave a fair kill, one containing 10 per cent. was less effective. Various combinations of pyrethrum and pyrethrum marc with sodium fluoride and dextrine were again tested, but little or no synergistic effect was noticed. Sodium pentachlorphenate could not be used in the dust chamber because it was too irritant and it gave poor kill by the dust ring method, but it showed some promise when used in water as a bait.

PAPERS NOTICED BY TITLE ONLY.

[PERFIL'EV (P. P.).] **Перфильев (П. П.). Sandflies of the Fauna of USSR. Revision of *Phlebotomus* belonging to the Group** *minutus* [including *P. murgabiensis* sp. n. from southern Turkmenistan]. [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **19** pp. 75–95, 18 figs., 26 refs. Leningrad, 1939. (With a Summary in English.)

PARROT (L.) & BOUQUET DE JOLINIÈRE (P.). **Notes sur les phlébotomes. XLVI. Nouveaux phlébotomes du Hoggar** [including three new records and two new species].—*Arch. Inst. Pasteur Algérie* **23** no. 1 pp. 56–63, 5 figs., 4 refs. Algiers, 1945.

SCHWETZ (J.). **Note supplémentaire sur la répartition des phlébotomes au Congo belge.**—*Rev. Zool. Bot. afr.* **33** fasc. 3 pp. 241–244, 1 ref. Brussels, 1940. [*Cf. R.A.E.*, B **26** 60.]

SCHOUTEDEN (H.). **La larve de l'*Anopheles dureni* Edw.** [from Kwango, Belgian Congo].—*Rev. Zool. Bot. afr.* **33** fasc. 4 pp. 293–294. Brussels, 1940.

PELAEZ (D.). **Anofelinos de México. I. Clave para la determinación de las especies y subespecies, basada en los caracteres de las hembras adultas.** [Anophelines of Mexico. I. Key for the Identification of the Species and Subspecies, based on the Characters of the Adult Females.]—*Ciencia* **6** no. 2 pp. 69–77, 58 figs. Mexico, D.F., 1945.

CONKLIN (J. G.). **Insect Record** [including first record of *Anopheles walkeri*, Theo., in New Hampshire].—*Bull. N.H. agric. Exp. Sta.* no. 351 (Rep. 1942–43) p. 40. Durham, N.H., 1943.

HAAS (V. H.) & EWING (F. M.). **Inoculation of Chick Embryos with Sporozoites of *Plasmodium gallinaceum* by inducing Mosquitoes to feed through Shell Membrane.**—*Publ. Hlth Rep.* **60** no. 7 pp. 185–188, 1 pl. Washington, D. C., 1945.

DE LEÓN (J. R.). **Apuntes para una monografía sobre los Simúlidos de Guatemala. Nuevas especies de Simúlidos en la región occidental de Guatemala.**—12 pp., 1 map, 18 figs., 2 refs. Guatemala, 1945.

HURST (H.). **Principles of insecticidal Action as a Guide to Drug Reactivity-Phase Distribution Relationships.**—*Trans. Faraday Soc.* **39** pt. 12 pp. 390–411, 1 fig., 46 refs. London, 1943. [*Cf. R.A.E.*, A **34** 85.]

WEBB (J. E.) & GREEN (R. A.). **On the Penetration of Insecticides through the Insect Cuticle** [with *Melophagus ovinus*, L., as test insect].—*J. exp. Biol.* **22** no. 1–2 pp. 8–20, 2 figs., 9 refs. London, 1945. [*Cf. R.A.E.*, A **34** 87.]

Lewis (P. M.), Buehler (M. H.) & Young (T. R.). **Plague in Dakar.**—*Bull. U.S. Army med. Dep.* no. 87 pp. 13–16. Washington, D.C., 1945.

An outbreak of plague, comprising 567 cases, of which 91 per cent. were fatal, occurred in Dakar (Senegal), from April to November 1944. Overcrowding, insanitary conditions and abundant rats and fleas favoured the spread of the disease. Some 10,500 rats were caught during the outbreak, and 65 out of 3,501 examined in the laboratory were infected with plague. Two dead cats were also found to be infected. As dusting with DDT as a supplementary measure for the control of fleas appeared to be having a highly beneficial effect, comprehensive treatment of all the native sections of the town was begun on 24th October. Practically the whole population was dusted with 10 per cent. DDT, which was applied with plunger-type dusters first to the ankles, then the various layers of clothing, at the waist, sleeves and neck and finally to the hair. Houses were dusted with 10 per cent. DDT or sprayed with 5 per cent. solution in kerosene. Spraying was preferred, but dusting was also used to make fuller use of available equipment. Attention was chiefly directed to the floor, lower walls and beds. The flea population was very greatly reduced by these measures. Out of 316 houses infested before spraying, 309 were completely free of fleas two weeks later. The effectiveness of the treatment in halting the outbreak of plague cannot be evaluated, as the seasonal decline had already begun.

Blanc (G.) & Woodward (T. E.). **The Infection of *Pedicinus albidus* Rudow, the Maggot's Louse, on Typhus carrying Monkeys** (*Macacus sylvanus*).—*Amer. J. trop. Med.* **25** no. 1 pp. 33–34, 2 figs., 5 refs. Baltimore, Md., 1945.

Certain experiments with *Pedicinus longiceps*, Piag., and typhus had been thought to indicate that the virulence of the rickettsiae is lost in passing through an unusual host [*cf. R.A.E.*, B **11** 200]. Accounts are given of two experiments that showed by dissection and by inoculation into guineapigs that *P. albidus*, Rudow, can acquire infection by feeding on monkeys infected with epidemic typhus and that the rickettsiae maintain their virulence and characteristics as do those of murine typhus after passage through lice and of epidemic typhus passed through fleas [*cf.* **29** 15, etc.]. This supports the results obtained in other work of a similar kind [**28** 129].

Anduze (P. J.). **Breve nota sobre miasis humanas en Venezuela.** [Short Note on Human Myiasis in Venezuela.]—*Bol. Ent. venezolana* **4** no. 1 pp. 37–40. Caracas, 1945. (With a Summary in English.)

There are very few published records of myiasis in man in Venezuela, but many cases are known to occur. Cutaneous myiasis caused by *Dermatobia hominis*, Say, is common in some parts, particularly the plains. One case at Caracas was attributed to *Cuterebra*, but this was probably accidental. Myiasis of the body cavities is most commonly nasal. The agent is unknown, except in one instance in which the larvae were reared and found to be a species of *Calliphora*. Only one proved case of gastro-intestinal myiasis is known from Venezuela. The larvae involved were of a species of *Sarcophaga*. With a view to furthering the study of the flies responsible for human myiasis, four media suitable for the sterile culture of Dipterous larvae are suggested.

Napier Bax (S.). **Report on the Work of the Tanganyika Tsetse Research Department since February, 1944.**—12 pp. multigraph, 2 graphs. Shinyanga, 1944. **Additions to the Report in order to bring it up to January, 1945.**—2 pp. typescript. [1945.]

In observations on the maintenance of *Glossina* in captivity, C. H. N. Jackson found that *G. morsitans*, Westw., kept at 100 per cent. relative humidity

and in darkness at outdoor temperatures in July and offered food every third day, on consecutive days if a feed was refused or two days after a partial meal, failed to synthesise fat in quantities comparable to those found in nature [*cf. R.A.E.*, B **25** 162]. Some of the flies died with full meals of undigested blood three days after feeding. F. L. Vanderplank reports that individuals of both sexes of the typical race (A) and race B of *G. morsitans* (from the central Tanganyika fly belt and the Tanganyika coastal belt, respectively), *G. swynnertoni*, Aust., *G. pallidipes*, Aust., *G. austeni*, Newst., *G. palpalis fuscipes*, Newst., *G. p. martinii*, Zumpt, *G. longipennis*, Corti, *G. fuscipleuris*, Aust., and *G. brevipalpis*, Newst., were kept singly in tubes and were fed solely on sheep or fowls. The blood of either appeared suitable for reproduction and longevity in all the species. Vanderplank also designed a feeding apparatus consisting of rat skin membranes, defibrinated blood, an electrical thermostatic heater and a centrifugal pump, which was satisfactory in trials and with which it is hoped that one operator will be able to feed up to 500 flies per hour and that longer life and better reproduction will be obtained.

Experiments on marking methods made by Jackson in the field during the rains failed to support earlier dry-season findings that small dark marks give better survival than large conspicuous ones [*cf.* **29** 161]. No difference could be found between dark blue, dark green, light green, red, yellow or white. In experiments by Vanderplank, screens treated with alcoholic extracts from the body surface of an ox were attractive to *G. pallidipes* [*cf.* **33** 100], catching about twice as many flies as unscented ones, and rather more than live bait [*cf.* **33** 56]. The scent increased catches of *G. swynnertoni* by about 50 per cent. Observations by Jackson supported the finding of Mellanby that humidity does not affect the metabolism of fat [**25** 93], though Buxton & Lewis [**23** 63] and Jack [**28** 22] obtained contrary results. At 25°C. [77°F.] and 50 per cent. relative humidity, males of *G. swynnertoni* lost as much weight in 24 hours as *G. morsitans*, and it follows that small flies are at a disadvantage. Jackson also found that the weight of flies of a given species is related to the length of their wings. Smaller flies in the field are at a disadvantage, for the wing lengths of teneral flies [those that have not fed and have soft chitin] tend to average less than those of non-teneral flies of the same emergence. At least three age groups of flies can be recognised from the degree of fraying of the wings, and life tables can be constructed from which data on length of life obtained by recapture of marked flies can be checked. Both methods are open to the possible objection that flies of a certain age may be less active than others. The age of flies has an important bearing on the occurrence in them of trypanosomes, since they require about three weeks to become infective and, conversely, observations on trypanosomes provide a useful check on the diagnosis of age from wing fraying. *G. morsitans* from Morogoro (race B) resembles *G. swynnertoni* in weight and wing length rather than *G. morsitans* from Kondoa Irangi (race A). J. P. Glasgow concludes from observations on the process of deteneralisation [hardening of chitin] in *G. morsitans* that it should be possible to develop a method of determining the age of teneral flies by examining sections of the cuticle, and that feeding causes a more rapid deposition of the endocuticle, which is not present at the time of emergence. He also thought that it might be possible to determine whether a fly had fed once or twice, and showed that at some stage between five and 21 days after emergence, the epidermis disappears and that this might give an indication of the age of flies within these limits. This, however, would require a more elaborate technique. Jackson established that youthful but non-teneral males are inactive between the first and second meals, and that females are much more active in the first week or two after the first meal than later. He also found that though fat is accumulated over a series of meals, the maximum is apparently reached in about three weeks.

In continued experiments on hybridisation [*cf.* **34** 35–36], Vanderplank observed that *G. palpalis fuscipes* and *G. p. martinii* will mate at random, but the large superior claspers of the males of *martinii* always fatally injured females of *fuscipes*. Offspring were obtained by cutting off the points of the claspers. Some of the female offspring were fertile, but the males were unable to mate successfully owing to abnormalities of the genital organs. Males of *G. austeni* were prepared to mate with most species of the *morsitans* group but were too small to do so if the females were of normal size. Races A and B of *G. morsitans* were found to be genetically and morphologically distinct. Male hybrids between them were sterile and the females partly so when back-crossed with either parental race. Race B crossed more readily with *G. swynnertoni* than with race A, this cross resulting in a higher production of offspring (sterile males and partly sterile females). Jackson found that *G. morsitans* introduced as pupae into the habitat of *G. swynnertoni* produces a considerable second generation unless *G. swynnertoni* is abundant enough to interfere considerably. *G. morsitans* under these conditions is of about the same weight as *G. swynnertoni*, after allowance has been made for the difference in size, which is about 10 per cent. *G. swynnertoni* has proportionately less fat and water and more residual dry weight, but *G. morsitans* is in substantially better condition in its own environment. *G. palpalis* did fairly well when introduced in a riverine habitat in a *G. swynnertoni* area, but failed completely away from the river. It appeared to feed on reptiles only. The ptilinum test for teneral flies cannot be used for *G. palpalis* as the ptilinum remains eversible for a month.

Measurements of *Trypanosoma congolense* have shown it to be dimorphic, and measurements of *T. rhodesiense* in relation to its electric charge have shown it to be tetramorphic. Vanderplank found *T. congolense* in a wild male of *G. austeni* at Kingolwira. In the course of dissection of some 30,000 wild males and females of *G. swynnertoni* and *G. pallidipes*, a definite seasonal variation in trypanosome infections was observed. In addition, the annual percentage of infected non-teneral adults of both species and the incidence of trypanosomiasis in the game animals of Shinyanga has decreased steadily for three years. The incidence of trypanosomes in game was highest in the wetter months. Vanderplank found two sexes in all trypanosomes examined, and it is thought that sexual reproduction takes place by an exchange of gametes in the fly. *T. brucei* has the same number of chromosomes as *T. rhodesiense* but in the former the Y chromosome is larger and more obvious.

At the end of 1944, numbers of *G. morsitans* were falling satisfactorily in a miombo area of Northern Rhodesia where fire-exclusion and clearing of drainage lines were being tried [**32** 188], and virgin non-teneral females were frequently caught. The numbers of *G. swynnertoni* continued to fall in a block where fire was being excluded and the hardpans cleared at Shinyanga [**32** 188], and non-teneral females showing abnormalities in fertilisation were found [*cf.* **33** 55], including one that was certainly not inseminated. A few flies were entering the block across isolating clearings, and there was apparently still an area of indigenous infestation in the middle. Selective clearing failed to eliminate *G. swynnertoni* from another block, which is six square miles in area, and a hybridisation experiment was therefore begun in June. Some 86,400 adults of race A of *G. morsitans* from Kondoa Irangi emerged from the 144,000 pupae introduced into the area. *G. morsitans* spread all over it and was seven times as numerous as *G. swynnertoni* during September and October, but only twice as numerous in November and December. The population of *G. swynnertoni* decreased to 33 per cent. of its original figure by October, whereas it only decreased to 80 per cent., owing to seasonal effect, in the control block. Hybrids were being recovered from the experimental block in increasing proportions at the end of the year.

DE BUCK (A.). **Een doorloopende broedplaats van** *Anopheles plumbeus* **Stph. in Amsterdam.** [A temporary Breeding Place of *A. plumbeus* in Amsterdam.] —*Ent. Ber.* **11** no. 243 pp. 15–16. [Amsterdam] 1942.

After hungry females of *Anopheles plumbeus*, Steph., had been observed in a cellar in Amsterdam, larvae of this Anopheline were found in the summer of 1936 in ground water that had accumulated on the floor of an inner compartment of the cellar. The water was brown, owing to the presence of dead leaves in it. Larvae occurred throughout the year, but development was suspended in autumn and winter and was not resumed before spring even by some that were transferred to a higher temperature. The water did not freeze in winter, but in an experiment, the larvae were unaffected by being kept in ice for a few days. *A. plumbeus* cannot be bred in the laboratory since the adults do not pair in small spaces, but eggs were obtained by leaving a small vessel containing some of the water exposed overnight in the cellar. No larvae were found out of doors in the vicinity.

ALVARADO (C. A.) & PEÑA (L. S.). **Aplicación de sifones antilarvarios en la República Argentina.**—*Bol. Ofic. sanit. panamer.* **23** no. 10 pp. 876–886, 6 figs., 6 refs. Washington, D.C., 1944.

Anopheles pseudopunctipennis, Theo., the only vector of malaria in north-western Argentina, breeds in running water. In this paper, flushing as a means of controlling Anopheline larvae in streams and its accomplishment by means of siphons or automatic sluices are explained. Siphons are considered preferable as they are more durable, simpler and less likely to get out of order, and require little upkeep. The properties necessary in an anti-larval siphon are compared with those required in siphons used for other purposes, and various types of anti-larval siphons are reviewed with reference to the literature [*R.A.E.*, B **31** 217, etc.]. The Macdonald siphon was found to be unsatisfactory, as the inflow and discharge sometimes reached equilibrium [*cf. loc. cit.*] and at other times discharge was too frequent and brief, and, after a study of the causes of the deficiencies by means of models with glass walls, an improved siphon was developed by the second author.

The new siphon has more gradual curves, which makes for greater efficiency in action, and is self-priming. The upper limb, which slopes forwards, is rectangular in cross-section, with parallel walls, but the cross-section of the lower limb, which slopes slightly backwards, decreases laterally and increases frontally, until at the bottom it becomes square. When the flow of water passes the crest, it is prevented from clinging to the posterior wall of the lower limb by an air inlet at the top of the latter, which equalises the air pressure, and strikes the lateral and frontal walls, thereby isolating the air in the throat above the crest and subsequently withdrawing it ; this action is greatly facilitated by the change in shape of the lower limb. The siphon is designed for use in batteries, and when this arrangement is adopted, pressure throughout the system is equalised by means of communication pipes, one let into the throat of each siphon and another into the mouth of the lower limb below the water seal ; the crest of one siphon is lower than those of the others, to induce rapid priming in them. With this arrangement, priming of a battery with a mean discharge of 500 gals. per second takes place with a flow of only 3 gals. per second. Siphonage is terminated throughout the battery by air admitted into the upper communication pipe from an air-pipe with a funnel-shaped mouth at the bottom opening into a chamber into which, with the fall in water level, air is admitted from a vertical pipe opening above the dam, where it cannot become choked by débris. Rapid entry of air is facilitated by the comparatively large perimeter of this funnel-shaped entrance, which should equal the sum of the widths of all the siphons in the battery.

The most important siphons that have been constructed in Argentina are those at Famaillá, in the Province of Tucumán, of which there are eleven in three batteries. They have proved effective in the control of *A. pseudopunctipennis* over 2½ miles of a stream with slow current and sandy bed, which in the past needed frequent canalisation and oiling. In this instance, the cost of the installation was less than that of carrying out routine temporary control measures for ten years, but the work was experimental and large-scale production should reduce cost much further. Breeding places of *A. argyritarsis*, R.-D., are the first found below the lowest siphons, then those of *A. albitarsis*, Arrib., and finally those of *A. pseudopunctipennis*.

ROTH (L. M.). **The Male and Larva of** *Psorophora* (*Janthinosoma*) *horrida* (**Dyar and Knab**) **and a new Species of** *Psorophora* **from the United States (Diptera : Culicidae).**—*Proc. ent. Soc. Wash.* **47** no. 1 pp. 1–23, 19 figs., 26 refs. Washington, D.C., 1945.

Descriptions are given of the adults of both sexes and the larva of *Psorophora* (*Janthinosoma*) *horrida*, D. & K., which is widely distributed in the south-eastern United States and occurs as far west as Iowa and the eastern parts of Kansas, Oklahoma and Texas, and of *P.* (*J.*) *longipalpis*, sp. n., which also occurs in the last three States as well as in South Dakota, Missouri and Arkansas. It is evident that they have been confused and that the new species is the one of which males were described by Matheson [*R.A.E.*, B **22** 120]. Previous literature on the status of *P. horrida* is reviewed, and notes from observations by C. B. Eaton on its biology and rearing in the laboratory are given.

STONE (A.). **A Mosquito Synonym (Diptera : Culicidae).**—*Proc. ent. Soc. Wash.* **47** no. 2 pp. 38–39. Washington, D.C., 1945.

The author states that *Aëdes* (*Luzonus*) *clavirostris*, Stone & Bohart [*R.A.E.*, B **33** 188] is a synonym of *Ficalbia* (*Etorleptiomyia*) *luzonensis*, Ludl., and consequently that the subgenus *Luzonus* falls within the scope of the subgenus *Etorleptiomyia* of *Ficalbia*.

DAVIS (D. E.). **The Control of Rat Fleas** (*Xenopsylla cheopis*) **by DDT.**—*Publ. Hlth Rep.* **60** no. 18 pp. 485–489. Washington, D.C., 1945.

Accounts are given of laboratory and field experiments in Texas on the control of *Xenopsylla cheopis*, Roths., on rats with DDT, with a view to using it as an auxiliary measure against typhus. Ten fleas placed in a pail with a little pure DDT all died in four hours, and 50 placed in a jar containing 1 gm. DDT and 100 gm. floor sweepings died within 24 hours. Controls lived for two days. To determine whether DDT will kill fleas on rats, examples of *Mus* (*Rattus*) *norvegicus* and *M.* (*R.*) *rattus alexandrinus* were caught and kept in cages in a protected place out-of-doors. Each rat was put for 10–15 minutes in a bag with 1 gm. powder containing DDT in proportions varying from 0·02 to 5 per cent., and then returned to the cage. Two days later, the rats were chloroformed and ectoparasites collected. The average number of fleas per rat was 0–0·3 in the batches treated with powders containing 0·62 per cent. DDT or more, 12·5 on those treated with the weakest powder, 4·5 on control rats and 19·1 on wild rats at the time of the tests. In an attempt to eradicate fleas under natural conditions, six rat-infested buildings were dusted with 20 per cent. DDT. The flea-indices of rats caught in them averaged 13·9 before dusting and 0·6 a month after dusting. Two of the buildings showed even lower indices four months after dusting ; rats from the others were not examined after so long. A shed was cleared of a heavy infestation of *Pulex irritans*, L., in 24 hours, a garage and a yard of a heavy infestation of *Ctenocephalides felis*, Bch., in two days and

another garage of an infestation of *C. felis* in 24 hours by dusting with DDT. Incidental observations suggested that DDT does not eliminate the mites, *Liponyssus bacoti*, Hirst, and *Echinolaelaps echidninus*, Berl., or the rat louse *Polyplax spinulosa*, Burm. *Echidnophaga gallinacea*, Westw., was found on rats from poultry houses that had been dusted with DDT.

The place of DDT in typhus control is discussed. It should probably be used before rats are trapped or poisoned in eradication campaigns, as the fleas leave the dead host and may thus spread the infection. It could also be used in buildings that cannot economically be freed of rats. It might be introduced into plague-control programmes and employed to check plague among wild, burrowing rodents. The dust should be directed along rat runs and into rat holes or burrows. Waste flour is a suitable diluent.

USINGER (R. L.). **The Triatominae of North and Central America and the West Indies and their Public Health Significance.**—*Publ. Hlth Bull. U.S. Publ. Hlth Serv.* no. 288, 83 pp., 12 pls., 5 figs., 6½ pp. refs. Washington, D.C., 1944.

In the systematic section of this paper, the author points out that a phylogenetic study has shown that Pinto's family TRIATOMIDAE [*R.A.E.*, B **15** 47] should be reduced to the status of a subfamily of Reduviids. Tribal status is accorded to Pinto's subfamilies TRIATOMINAE and RHODNIINAE. The paper comprises the results of a study made between 1936 and 1943 of every species and subspecies of TRIATOMINAE from North and Central America and the West Indies. Structures used in classification are shown diagramatically. Descriptions are given of the tribes, genera and species occurring in the area, together with keys to them and to the eggs and last-instar nymphs of some species. There are two new tribes, and one new genus, *Nesotriatoma*, which is erected for *Triatoma flavida*, Neiva (the type) and *N. bruneri*, sp. n., both from Cuba, and five new subspecies of species of *Triatoma*. It is considered that *T. heidemanni*, Neiva, is a synonym of *T. lecticularius*, Stål, that *T. ambigua*, Neiva [*cf.* **31** 234] and *T. indictiva*, Neiva, are subspecies of *T. sanguisuga*, Lec., and that *T. longipennis*, Usinger, and *T. sonoriana*, Del Ponte, are subspecies of *T. phyllosoma*, Burm., and *T. rubida*, Uhl., respectively.

The geographical distribution of the TRIATOMINAE is discussed, and data are given on their life-history, relation to *Trypanosoma cruzi* and feeding and flight habits, and the hosts from which various species have been recorded. Notes on collecting and rearing are included. Reservoirs and Triatomine vectors that have been found naturally infected with *T. cruzi* in the area and others that have been experimentally infected are shown in tables, and a list is given of ticks and insects other than Triatomids that have been experimentally infected with the trypanosome and of insects (all Hemiptera) in which it reaches the infective stage.

FLOCH (H.) & ABONNENC (E.). **Recherche de la trypanosomiase humaine américaine en Guyane française. Les Triatomidés vecteurs.**—*Publ. Inst. Pasteur Guyane* no. 23, 6 pp., 1 fig., 11 refs. Cayenne, 1941. **Note sur l'élevage des Triatomidés à l'Institut Pasteur de la Guyane.**—*Op. cit.* no. 33, 10 pp., 1 pl., 7 refs. 1942. **Triatomidés et maladie de Chagas. Présence de** *E. mucronatus* **en Guyane française et infection naturelle de** *R. pictipes* **par** *S. cruzi*.—*Op. cit.* no. 70, 4 pp., 6 refs. 1943.

It is stated in the first paper that a locally-acquired case of Chagas' disease, which is caused by *Trypanosoma* (*Schizotrypanum*) *cruzi*, was reported from French Guiana in 1940 and subsequent investigation showed that *Dasypus*

novemcinctus was a reservoir. A list is given of the Triatomines that had been found naturally infected with the trypanosome in other countries. They include *Panstrongylus geniculatus*, Latr., *Triatoma rubrofasciata*, Deg., and *Rhodnius prolixus*, Stål, which with *R. pictipes*, Stål, and *R. robustus*, Larrousse, had previously been recorded in French Guiana. The distribution of the five species is briefly reviewed. One female each of *R. prolixus* and *R. pictipes* were found again in the Inini Territory in 1941, and numerous examples of both sexes of *T. rubrofasciata* at Cayenne. The female of *R. prolixus* was heavily infected with *Trypanosoma cruzi*.

The second paper contains data on the technique used in rearing a generation of *R. prolixus* from the infected female and one of *Triatoma rubrofasciata* also from the material referred to in the first paper and on their life-cycles as observed during this work. The female of *R. prolixus*, which had paired before being taken and lived 5½ months in captivity, laid 250 eggs, of which 211 hatched. The last two eggs to hatch did so 35 days after the laying of the last batch, more than five months after the female was caught. The shortest life-cycle from egg to adult occupied 134 days in *R. prolixus* and 116 in *T. rubrofasciata*. Mortality was nearly 50 per cent. in the former (occurring chiefly in the first two nymphal instars) and 38 per cent. in the latter. *R. prolixus* was easily infected with *Trypanosoma cruzi*, even in the early nymphal instars, the metacyclic and crithidial forms appearing in the dejecta 18–20 days after the first infecting meal. Nymphs of *Triatoma rubrofasciata* of instars earlier than the fifth were infected experimentally, but only with difficulty. Metacyclic forms did not appear until 65 days after the first infective meal. In *R. prolixus*, blackish dejecta are emitted five minutes after a feed, then clear dejecta at intervals of two minutes, the first brownish, the remainder water-white. It is in these clear dejecta, particularly the first, that the metacyclic and crithidial forms of *Trypanosoma cruzi* are most plentiful. No instance of coprophagy was observed in either species or of cannibalism in *R. prolixus* ; young nymphs of *Triatoma rubrofasciata* often fed on others of their own species, but did not apparently harm them in doing so [*cf.* **3** 56].

It is recorded in the third paper that an uninfected male of *Eratyrus mucronatus*, Stål, was taken at Cayenne in 1943 and a female of *R. pictipes* at Cayenne and a male at Montjoly, about six miles away. An account is given of the rearing of offspring from this pair, both of which were infected with *Trypanosoma cruzi*. The first dejecta were thick and black, the remainder liquid and ochre-coloured. The black dejecta of both were shown to be infective by injection into guineapigs. The male of *E. mucronatus* would not engorge. An uninfected individual of *P. geniculatus* was taken at Montjoly and two more of *Triatoma rubrofasciata* in Cayenne. Both these were infected with trypanosomes that were morphologically identical with the metacyclic form of *T. cruzi* but did not develop in guineapigs.

Floch (H.) & Abonnenc (E.). **Trombidides de la Guyane française, I-III.**—*Publ. Inst. Pasteur Guyane* no. 20, 22 pp., 7 figs., 9 refs. Cayenne, 1941 ; no. 40, 3 pp., 2 pls., 7 refs., 1942 ; no. 64, 4 pp., 2 figs., 2 refs., 1943.

Descriptions are given in the first paper of the larvae of *Trombicula flui*, Van Thiel, and *T. vanommereni*, Schierbeek, the hosts of both of which include man and dogs, *T. canis*, sp. n., and *Schöngastia guyanensis*, sp. n., each of which was collected from these two hosts, *T. avis* from a bird, *Trombidium muscae*, sp. n., from *Musca domestica*, L., and *T. cicindelae*, sp. n., from a Cicindelid.

The second and third papers contain, respectively, descriptions of adults of a new and an unnamed species of Trombidiid [*sens. str.*] of which the hosts are not known.

Floch (H.) & Abonnenc (E.). **Myiases humaines en Guyane française.** *Cochliomyia hominivorax* **et** *Cochliomyia macellaria.*—*Publ. Inst. Pasteur Guyane* no. 46, 4 pp., 2 figs., 6 refs. Cayenne, 1942.

Detailed examination of larvae taken from cases of nasal and cutaneous myiasis of man in Cayenne and adults reared from them and of larvae and adults taken from rubbish dumps, carcases of animals and decomposing meat showed that, although they appeared superficially the same, those that caused myiasis were *Cochliomyia hominivorax*, Coq., while those living on dead matter were *C. macellaria*, F. [*cf. R.A.E.*, B **23** 11]. The distinguishing characters of the adults of both sexes and the third-instar larvae are given.

Floch (H.) & Abonnenc (E.). **Sur la myiase à** *Dermatobia cyaniventris* **en Guyane française. Rôle vecteur de** *Mansonia titillans* **(Walker, 1843).**—*Publ. Inst. Pasteur Guyane* no. 85, 3 pp., 4 figs. Cayenne, 1944.

Infestation of man by *Dermatobia hominis*, Say (*cyaniventris*, Macq.) is frequent in French Guiana in the heart of the forests as well as on their edges. Cattle, buffalo, dogs and pigs are also attacked. It was found that the larva could easily be removed by pressure if the opening of the cyst was first cleaned with alcohol and covered with cotton-wool soaked in collodion for a few hours. Eggs of *D. hominis* were found on an adult of *Psorophora lutzi*, Theo., and one of *Mansonia titillans*, Wlk., which is very common locally, and one case of multiple infestation in man occurred in a place where *P. ferox*, Humboldt, was so abundant that it was thought to be probably responsible for carrying the eggs.

Floch (H.) & Abonnenc (E.). **Cératopogonidés hématophages de la Guyane française. I-II.**—*Publ. Inst. Pasteur Guyane* no. 37, 10 pp., 3 figs., 3 refs.; no. 49, 5 pp., 1 fig., 4 refs. **Cératopogonidés divers de la Guyane française. III.**—*Op. cit.* no. 55, 6 pp., 2 figs., 5 refs. Cayenne, 1942.

The first paper contains morphological notes on eight species of *Culicoides* occurring in French Guiana, including *C. guyanensis*, sp. n. *C. amazonicus*, Macfie, *C. horticola*, Lutz, and the new species are reported to attack man. The second paper deals similarly with five species of *Culicoides* including a new one and one discussed in the first, and the third paper with Ceratopogonids of other genera.

Floch (H.) & Abonnenc (E.). **Phlébotomes de la Guyane française. I–XV.**—*Publ. Inst. Pasteur Guyane* no. 15, 22 pp., 6 figs., 15 refs.; no. 28, 16 pp., 5 figs., 3 refs.; no. 30, 16 pp., 1 fldg tble, 3 figs., 11 refs.; no. 38, 15 pp., 6 figs., 6 refs.; no. 61, 30 pp., 14 figs., 12 refs.; no. 62, 9 pp.; no. 80, 20 pp., 6 figs., 9 refs.; no. 81, 18 pp., 6 figs., 10 refs.; no. 83, 11 pp., 5 figs.; no. 88, 22 pp., 13 figs., 6 refs.; no. 90, 24 pp., 10 figs., 4 refs.; no. 95, 4 pp., 2 figs., 5 refs.; no. 98, 4 pp., 1 pl.; no. 100, 22 pp., 8 figs., 40 refs.; no. 106, 16 pp., 6 figs., 8 refs. Cayenne, 1941–1945.

A study of the species of *Phlebotomus* occurring in French Guiana was made in view of the occurrence there of cutaneous leishmaniasis caused by *Leishmania brasiliensis*. Those found, including many new ones, are described in this series of papers, except the sixth and fourteenth, which comprise keys to the males and females, respectively, of the American species. Records in the earlier parts of *P. intermedius*, Lutz & Neiva, which, according to Aragão is the usual vector of *L. brasiliensis* in Brazil [*R.A.E.*, B **16** 85, 170; but *cf.* **31** 17, 111], are shown in later ones to be erroneous.

Floch (H.), de Lajudie (P.) & Abonnenc (E.). **Sur** *Aëdes* (*Stegomyia*) *aegypti* **Linné, 1762, et sa variété** *luciensis* **Theobald, 1907.**—*Publ. Inst. Pasteur Guyane* no. 35, 7 pp., 1 fig. Cayenne, 1942.

From the results of examination of specimens caught in nature, selective breeding through successive generations and cross-breeding experiments, it is concluded that the population of *Aëdes aegypti*, L., in French Guiana comprises 70 per cent. of the typical form with the fifth joint of the posterior tarsi completely white, 5 per cent. of var. *luciensis*, Theo., with the apical half of this joint black, and 25 per cent. of individuals with a smaller amount of black on the fifth joint, which result from the crossing of the other two.

Floch (H.) & Abonnenc (E.). **Espèces de moustiques signalées pour la première fois en Guyane française.**—*Publ. Inst. Pasteur Guyane* no. 41, 6 pp., 8 refs. Cayenne, 1942. *Chagasia bonneae* **en Guyane française.**—*Op. cit.* no. 42, 3 pp., 1 fig., 4 refs. 1942. **Catalogue et distribution géographique des moustiques de la Guyane française actuellement connus.**—*Op. cit.* no. 43, 10 pp., 16 refs. 1942. **Culicidés et Ixodidés guyanais. Moustiques signalés pour la première fois et présence de** *Ornithodorus talaje* **en Guyane française.**—*Op. cit.* no. 86, 6 pp., 12 refs. 1944.

The 125 species of mosquitos in the third paper include 15 Anophelines, of which ten had been recorded from French Guiana in papers already noticed [*R.A.E.*, B **26** 67 ; **27** 210 ; **30** 150] and the others (*Chagasia bonneae*, Root, *Anopheles eiseni*, Coq., *A. intermedius*, Chagas, *A. maculipes*, Theo., and *A. mediopunctatus*, Theo.) are among those dealt with in the first two papers of this series.

The additional Anophelines in the fourth paper are *A. nimbus*, Theo., *A. peryassui*, D. & K., *A. squamifemur*, Antunes, *A. pessôai*, Galvão & Lane, and *A. goeldii*, Rozeboom & Gabaldon. The other mosquitos include *Haemagogus albomaculatus*, Theo. (also a new record) and *H. capricorni*, Lutz, which was recorded in the first and third papers as *H. equinus*, Theo. This genus is of particular interest as members of it have been shown to carry jungle yellow fever in other parts of South America [**32** 230, etc.].

The fourth paper also contains a record of the finding of a nymph of *Ornithodoros talaje*, Guér., in a cave near Cayenne in 1944. It was not infected with spirochaetes, but a case of tick-borne relapsing fever in man had been observed in French Guiana a few years before. Another nymph of *Ornithodoros* was recorded from the colony in the second of a previous series of papers by the authors [**33** 180], but its specific identity is uncertain.

Floch (H.) & Abonnenc (E.). **Sur** *A. darlingi* **Root 1926, en Guyane française. Gîtes larvaires, morphologie et moeurs.**—*Publ. Inst. Pasteur Guyane* no. 65, 7 pp., 11 refs. **Sur le rôle de** *A. darlingi* **Root 1926 dans la transmission du paludisme en Guyane française.**—*Op. cit.* no. 71, 10 pp., 5 refs. Cayenne, 1943.

In the first paper, data on the breeding places of *Anopheles darlingi*, Root, and the house-frequenting habits of the adults are reviewed from the literature and from observations in French Guiana, where it was first recorded in 1934 [*R.A.E.*, B **26** 66]. Adults and larvae have since been found along the whole length of the island of Cayenne and at various places in the interior but not in the town of Cayenne, which is swept by Atlantic winds. The breeding places differ greatly but are usually in open situations sheltered from wind and sometimes partly shaded from the sun. The water is acid in reaction and of low mineral content and the vegetation varied. A study of eggs laid by females from different localities in French Guiana showed that there were forms corresponding to those

described by Root and by Galvão, Lane & Corrêa [*cf.* **31** 50, etc.] and an intermediate form. Sometimes they occurred alone and sometimes all three together in one batch. The adults reared from these eggs showed no differences of any consequence, and the authors conclude that *A. darlingi* cannot at present be divided into varieties [*cf.* **31** 50]. *A. darlingi* represented 91 per cent. of the *Anopheles* taken in houses throughout the year but only 12 per cent. of those taken in woods.

In the second paper, it is pointed out that it is most abundant in June–August when malarial endemicity is increasing and that it prefers to feed on man although it has been observed to attack fowls and ducks and is occasionally taken in traps containing horses. Data are given from the literature on its natural infection with malaria parasites in other countries. Dissection of 542 females taken in French Guiana showed seven to be infected, six with oöcysts and two with sporozoites. As the mosquitos were not from large centres of population, *A. darlingi* is thought to be an important local vector in spite of this comparatively low infection rate. Of females that survived for more than four days after being fed on gametocyte carriers, five out of 14 became infected with *Plasmodium falciparum*, the commonest malaria parasite in French Guiana, and one out of six with *P. vivax*. In one instance infection with *P. falciparum* developed to the sporozoite stage.

Floch (H.) & Abonnenc (E.). **Sur *A. aquasalis* Curry, 1932.**—*Publ. Inst. Pasteur Guyane* no. 68, 9 pp., 2 figs., 4 refs. ***A. aquasalis* Curry 1932 et paludisme en Guyane française. Infection naturelle et infection expérimentale.**—*Op. cit.* no. 72, 8 pp., 4 refs. Cayenne, 1943.

The species of *Anopheles* of the subseries *oswaldoi* [*R.A.E.*, B **29** 177] known to occur in French Guiana when these papers were written were *A. ininii*, Senevet & Abonnenc, and *A. oswaldoi*, Peryassú, both of which had been found only in the interior, and *A. aquasalis*, Curry (previously referred to as *A. tarsimaculatus*, Goeldi [**27** 211]). In view of the discovery in Venezuela of the three closely related coastal species, *A. nuñez-tovari*, Gabaldon, *A. rangeli*, Gabaldon, Cova-García & López, and *A. goeldii*, Rozeboom & Gabaldon [**29** 177, 178, 181], data on the wing and tarsal colouring of these three and *A. oswaldoi* and *A. aquasalis* are quoted from Gabaldon & Aguilera [**29** 180]. However, they do not make accurate differentiation possible and in order to identify with certainty the mosquitos occurring on the coast of French Guiana and referable from examination of females to *A. aquasalis*, progeny were reared from several caught in nature. Examination of the adults and male hypopygia showed them to agree with *A. aquasalis*. There was considerable variation among eggs of a single batch. This is the only species of *Anopheles* occurring in houses in Cayenne, but over the rest of the coast it represents 51 per cent. of the *Anopheles* taken in woods but only 6 per cent. of those taken in houses. It attacks both man and animals. Larvae were found at all seasons and occurred in fresh and brackish water. They were very adaptable, surviving transfer from salt water (19 gm. sodium chloride per litre) to fresh and from fresh to salt [*cf.* **29** 178].

Further information is given in the second paper on the occurrence of *A. aquasalis* in Cayenne, where it is found on outside walls and in dark corners of kitchens, ground-floor rooms and sheds and rarely in mosquito nets. Dissection of 117 females from various parts of the Colony failed to reveal any natural infection with malaria parasites. However, undoubted cases of locally acquired malaria occurred in 1940 in Cayenne where there is no other Anopheline, and experimental infection was obtained with *Plasmodium falciparum* in seven out of 30 females that survived for more than four days and with *P. vivax* in ten out of 28. In one case, infection with *P. falciparum* developed to the sporozoite stage. *A. aquasalis* thus appears to be more susceptible to *P. vivax*

than *A. darlingi*, Root [*cf.* preceding abstract], but it is thought to be only a secondary vector of malaria in view of its habit of feeding indifferently on man or animals.

FLOCH (H.) & ABONNENC (E.). *A. triannulatus* **Neiva et Pinto en Guyane française. Morphologie des oeufs et infection expérimentale par** *P. falciparum* **et** *P. vivax*.—*Publ. Inst. Pasteur Guyane* no. 77, 7 pp., 1 fig., 4 refs. Cayenne, 1944.

Larvae of *Anopheles triannulatus*, Neiva & Pinto (*bachmanni*, Petrocchi) were found in French Guiana in 1934 [*R.A.E.*, B **26** 67], and six adults have since been taken in dwellings and two in forest, as well as numerous larvae in fairly varied breeding places. Descriptive notes are given on the forms of eggs of this species differentiated by Rozeboom and by Causey, Deane & Deane in papers already noticed [**31** 51 ; **32** 182] and on eggs obtained from a female taken near Cayenne attempting to feed on man in the late afternoon. These most closely resemble types one and two of Causey, Deane & Deane, but do not correspond with either of them exactly. Brief notes on the feeding habits of *A. triannulatus* and its experimental infection with malaria parasites are given from the literature. It attacks both man and animals. In experiments in French Guiana with reared adults, three females out of ten that lived more than four days became infected with *Plasmodium vivax* and one out of 16 with *P. falciparum*. No female had a gland infection.

FLOCH (H.) & DE LAJUDIE (P.). **Action de la roténone sur certaines espèces de Culicidés appartenant aux genres** *Culex*, *Anopheles* **et** *Aëdes*, **à leurs différents stades d'évolution.**—*Publ. Inst. Pasteur Guyane* no. 101, 10 pp., 18 refs. Cayenne, 1945.

The literature on the effects of rotenone on mosquito larvae is briefly reviewed, and an account is given of experiments carried out in French Guiana on the toxicity of a commercial powder of *Lonchocarpus* root (timbo) containing 5 per cent. rotenone and rotenoids (tephrosin, deguelin and toxicarol) to mosquitos of various species and in different stages. The tests were made at 28°C. [82·4°F.].

The following is largely based on the authors' conclusions. When the powder was used at a concentration of 1 mg. per 150 cc. water, the percentages of third-instar larvae dead in four days were 95 for *Aëdes taeniorhynchus*, Wied., 90 for *Culex coronator*, D. & K., and *C. fatigans*, Wied., 30–40 for *Anopheles darlingi*, Root, *A. triannulatus*, Neiva & Pinto (*A. bachmanni*, Petrocchi) and *A. aquasalis*, Curry, and 10 for *Aëdes aegypti*, L. (*Stegomyia fasciata*, F.), but the eggs of *A. aegypti* were more susceptible than those of *C. fatigans*, usually failing to hatch in water containing 10 mg. powder per 100 cc. At the latter concentration, the powder gave complete mortality, in three days or less, of the larvae of all the species except *A. aegypti*, 10 per cent. of which survived and gave rise to normal adults. Mosquito larvae were much less susceptible than the larvivorous fish, *Poecilia* sp., which was killed in a few hours by 1 mg. powder per 750 cc. water. Pupae were more resistant than larvae. *C. coronator*, one of the most susceptible of the species studied in the larval stage, had the most resistant pupae. When a spray, made by macerating 65 gm. powder in a mixture of 600 cc. kerosene and 65 cc. petrol for a few days and filtering, was atomised round a cage containing adults of *Anopheles aquasalis* and species of *Mansonia*, *Psorophora*, *Aëdes* and *Culex*, 45 per cent. were dead in an hour and 98 per cent. in 24 hours, the species showing no apparent differences in susceptibility.

Floch (H.) & de Lajudie (P.). **Sur les divers indices endémiques du paludisme en Guyane française.**—*Publ. Inst. Pasteur Guyane* no. 107, 10 pp., 11 refs. Cayenne, 1945.

The results of recent malaria surveys made in the interior of French Guiana are given and compared with similar data for Cayenne. The spleen, parasite, and gametocyte rates were 44, 24 and 7 in the interior and 12, 6 and 0·3 in Cayenne. *Plasmodium falciparum* was responsible for 85 per cent. of cases, whereas 68 per cent. were attributable to *P. vivax* in 1917. A list is given of the 21 species of Anophelines known to occur in French Guiana. All have been recorded in earlier papers of this series [*R.A.E.*, B **34** 57] except an unidentified species of the subgenus *Stethomyia* of *Anopheles*. *A. darlingi*, Root, is stated to be the principal vector of malaria, though it has not yet been taken in the regions dealt with in this survey. *A. aquasalis*, Curry, and *A. triannulatus*, Neiva & Pinto (*bachmanni*, Petrocchi) have been experimentally infected [**34** 58, 59] but attempts to infect *A. pessôai*, Galvão & Lane, and *A. mediopunctatus*, Theo., failed.

Causey (O. R.), Deane (M. P.), da Costa (O.) & Deane (L. M.). **Studies on the Incidence and Transmission of Filaria, *Wuchereria bancrofti*, in Belem, Brazil.**—*Amer. J. Hyg.* **41** no. 2 pp. 143–149, 2 pls. Lancaster, Pa., 1945.

An examination made in 1942–43 of thick blood films from 5,000 persons from various sections of the city of Belem in the State of Pará, Brazil, showed that 10·8 per cent. harboured microfilariae, all *Filaria* (*Wuchereria*) *bancrofti*. Elephantiasis was observed in 1·3 per cent. of the persons examined. The incidence of filariasis increased with age. The chief vector was *Culex fatigans*, Wied., which is extremely abundant ; 118 females among 1,014 dissected were positive for filaria larvae. Eight females had infective larvae in the head and the others had various stages, including infective larvae, in the thorax. In routine catches from bed-rooms over a period of seven months, an average of 334 mosquitos per house was collected and more than 99 per cent. of the identifiable specimens were *C. fatigans*. Natural infections were also found in three out of 563 females of *Anopheles darlingi*, Root, and two out of 332 of *A. aquasalis*, Curry. One female of the former contained infective larvae in the head and one of the latter infective larvae in the thorax. Experimental infections were produced in these three species and in *A. oswaldoi*, Peryassú, *A. triannulatus*, Neiva & Pinto, and *A. albitarsis*, Arrib., but not in four other species of *Anopheles*.

Patiño-Camargo (L.), de Zulueta (J.) & Toro (G.). **Persistencia del virus de la fiebre petequial en Tobia en el Argasidio** *Ornithodoros parkeri*. [Persistence of the Agent of Tobia Spotted Fever in *O. parkeri*.]—*Bol. Ofic. sanit. panamer.* **23** no. 11 pp. 978–980, 9 refs. Washington, D.C., 1944. (With a Summary in English.)

In spite of the presence in the Tobia Valley, Colombia, of *Amblyomma cayennense*, F., and *Rhipicephalus sanguineus*, Latr., which are vectors of São Paulo spotted fever in Brazil and Marseilles fever in France, respectively, and of Trombiculids, a family to which belongs the vector of tsutsugamushi disease in Japan, epidemiological evidence indicates that a species of *Ornithodoros* is the most likely vector of Tobia spotted fever. Davis showed the ability of *O. parkeri*, Cooley, to transmit the Colombian and other forms of spotted fever [*R.A.E.*, B **32** 103] and to remain infected with the spotted fever of the United States for 1,119 days. It is here reported that the agent of Tobia spotted fever, acquired by biting a guineapig in the acute stage of the disease, was shown by

inoculation into guineapigs to have persisted in an adult of *O. parkeri* from the United States for 1,087 days. *O. rudis*, Karsch, is abundant in the Tobia region and has been experimentally infected with Tobia spotted fever [**31** 43 ; **32** 85].

SYNERHOLM (M. E.), HARTZELL (A.) & ARTHUR (J. M.). **Derivatives of Piperic Acid and their Toxicities toward Houseflies.**—*Contr. Boyce Thompson Inst.* **13** no. 9 pp. 433–442, 19 refs. Menasha, Wis., 1945.

In view of the insecticidal activity of extract of black pepper (*Piper nigrum*) [*R.A.E.*, B **33** 24] and the high toxicity to house-flies (*Musca domestica*, L.) of piperine, its principal alkaloidal constituent [**32** 73], various amides and esters of piperic acid were tested as fly-sprays by the Peet-Grady method. It is concluded from the results that a wide variety of esters and substituted amides of piperic acid are toxic to house-flies. The most toxic amides are those derived from primary or secondary alkyl amines containing from three to seven carbon atoms. In the ester series, the most effective are derived from alcohols with more than three but less than seven carbon atoms. The amides and esters of piperic acid have a synergistic action when used in conjunction with pyrethrins against house-flies. Esters prepared from phenols and amides from aromatic amines are relatively non-toxic. The methylenedioxy group, which appears to be important in ascribing toxicity to the piperic acid residue, does not enhance the activity when it appears also in the substituents. The presence of a thiocyano group in either an aliphatic or an aryl piperate renders the compound less effective. The presence of halogens does not seem to improve the activity. In some cases, namely the esters, their presence appears to impair the effectiveness. Piperic acid itself is devoid of insecticidal activity. Descriptions and analyses are given of 25 previously unreported amides of piperic acid and 22 new piperic acid esters.

HARTZELL (A.). **Histological Effects of certain Sprays and Activators on the Nerves and Muscles of the Housefly.**—*Contr. Boyce Thompson Inst.* **13** no. 9 pp. 443–454, 4 figs., 15 refs. Menasha, Wis., 1945.

The following is almost entirely based on the author's summary. The effects of eight fly-sprays and activators were observed in histological preparations of nerve and muscle tissues of adult house-flies (*Musca domestica*, L.) sprayed under Peet-Grady test conditions. They included Lethane 384, Thanite and D.H.S. Activator, of which the active ingredients are n-butyl carbitol-thiocyanate, a thiocyanate of a secondary terpene alcohol and ethylene glycol ether of pinene, respectively. Flies were selected that would elicit some minor response upon stimulation but were unable to fly. The tissues examined were mainly of the brain and thoracic ganglia and also from a pair of muscles that run from the occiput to the base of the proboscis on either side of the caudal part of the brain.

Pyrethrum and its activators, sesame oil and piperine, produced characteristic effects on the brain. Pyrethrum poisoning was characterised by the destruction of the fibre tracts and the separation of the tissue by clear spaces, and piperine poisoning by prominence of the nerve fibres with almost complete destruction of the cellular components. Sesame oil when used alone produced effects in the nerve cells only at extremely high concentrations, but when used at regularly recommended strengths in combination with pyrethrum produced striking histological effects including vacuolation of the brain tissue and degeneration of the nerve cells. The effects of Lethane 384 and D.H.S. Activator on brain tissue were similar to that of piperine in that the nerve fibres were very prominent, while thanite, like sesame oil, caused vacuolation round large nerve cells. Rotenone at lethal concentrations produced no observed histological effect except at concentrations sufficient to cause " knockdown ", in which case vacuolation of nerve tissue was pronounced. DDT caused slight

dissolution of the fibre tracts and degeneration of the nuclei both in the brain and in the fused thoracic ganglia, but in spite of its pronounced neurologic symptoms, histological changes were relatively slight.

The muscles of flies that had been treated with pyrethrum showed the nuclei clumped into rod-like dense masses due to the clustering of the chromatin [*cf.* **31** 48]. DDT had the same effect to a smaller degree. In the case of flies treated with sesame oil or D.H.S. Activator, the muscle nodes and Krause's membrane were greatly accentuated, and piperine had a similar though less pronounced effect. Lethane 384 caused destruction of the nuclear membrane of the muscles. Little or no pathologic change was observed in the muscles of flies treated with rotenone or Thanite.

Evidence is presented that activation is due to the destruction of at least two tissue components, the poison having an affinity for one component and the activator for another and both at lower concentrations than when used alone.

BLAXTER (K. L.). **Control of Flies in Cowsheds. Experiments with D.D.T.**—*Agriculture* **52** no. 3 pp. 112–115. London, 1945.

As a preliminary to experiments made in various parts of Great Britain on the possible use of DDT against flies in farm buildings, it was ascertained that DDT was not toxic to farm animals when administered in large quantities by mouth, rubbed into the skin or injected beneath the skin or into the eye. The main experiments consisted in spraying the inner walls of farm buildings with a proprietary preparation containing DDT at twice the strength normally sufficient to kill flies. Hundreds of dead flies were collected from the floors of treated cow-sheds, but the numbers on the cows at milking time were not reduced appreciably. This was because most of the flies enter and leave the sheds with the cows and, though the members of the house-fly group (species of *Musca* and *Fannia*) settle in numbers on the walls, the blood-sucking flies do not. Of the latter, *Stomoxys calcitrans*, L., hovers round the cows, feeding intermittently until engorged, and then seeks sunny walls on which to rest, and the species of *Siphona* (*Haematobia* and *Lyperosia*) remain on the animals except when they leave them to oviposit. In calf pens and piggeries, in which the animals are housed continuously, substantial reductions in the numbers of flies were obtained, and the deposit was toxic for at least four weeks, but control was complete only if windows and ventilators were screened to prevent reinfestation. In preliminary tests of the effect of spraying the cows themselves, the treated animals had as many flies on them as the controls, and these flies still caused considerable annoyance.

Further experiments showed that a single dusting of cattle or pigs with DDT will free them of lice.

BARNES (S.). **The Toxicity of Distempers containing DDT.**—*J. Oil Col. Chem. Ass.* **28** no. 303 pp. 181–184, 2 refs. Slough, 1945.

An account is given of an investigation of the practicability of rendering distemper films toxic to *Cimex lectularius*, L., by the addition of DDT. The sample used was 80 per cent. pure. Small panels were coated with the various distempers and used for the tests 6–10 days, two months and, in a few cases, six months after being coated. A test consisted in exposing 36 adult bugs in batches of six for 24 hours on panels coated with the same distemper and making mortality counts after six days. During the intervals between tests, the panels were hung on a wall facing a window. The highest mortality among controls was 3 per cent. In similar work carried out by J. R. Busvine with *Musca domestica*, L., the flies were exposed in batches of 24–41 for 15–180 minutes in small wooden boxes coated on the inside with a distemper containing DDT and were then kept for 24 hours in recovery cages with sugar and

water. Exposure for 45 and 180 minutes to a dry distemper film containing 0·4 mg. DDT per sq. cm. 6–10 days after application gave 83 and 100 per cent. kill of *Musca* [*cf. R.A.E.*, B **33** 77], whereas exposure for 24 hours to the same film killed only 25 per cent. of *Cimex*. Mortality varied according to the way in which the DDT was incorporated in the distemper. It was sometimes as low as 3 per cent. and with a deposit of 0·4 mg. per sq. cm. was highest when the DDT was added as aqueous paste after milling. With this method of preparation, deposits of 0·4, 0·7 and 1·4 mg. per sq. cm. gave 37, 42 and 63 per cent. kill, respectively, after 6–10 days and 39, 47 and 65 per cent. after two months. The DDT was more effective when incorporated in the distemper in large particles than as a finely ground powder. Toxicity was not decreased by storage of the preparation for two months before use and was not affected by the temperature of the distemper when the DDT was added. The presence of DDT neither prevented the distemper being brushed out into a thin film nor diminished its durability. However, from unpublished work by Busvine, it is estimated that DDT is about 40 times less effective against *Musca* when incorporated in a distemper than when freely available on the surface, and comparison with earlier work by the author [**34** 26] shows it to be 140 times less toxic to *Cimex* when used in distemper than when applied to the surface dissolved in oil.

Hertig (M.) & Fisher (R. A.). **Control of Sandflies with DDT.**—*Bull. U.S. Army med. Dep.* no. 88 pp. 97–101, 1 fig. Washington, D.C., 1945.

The habits of sandflies (*Phlebotomus*) are briefly described, and accounts are given of experiments on the effectiveness of DDT sprays against them. In laboratory tests in Italy, contact with DDT gave knockdown without recovery of *P. perniciosus*, Newst., and *P. minutus*, Rond. (*parroti* var. *italicus*, Adl. & Thdr.) in 6–15 minutes and of *P. papatasii*, Scop., in 15–40 minutes. More extensive experiments were made in Palestine at a settlement in salt desert at the northern end of the Dead Sea where *P. papatasii* is abundant and the cutaneous leishmaniasis [*Leishmania tropica*] transmitted by it is endemic. The living quarters were bungalows of smoothly finished cement. Spraying the interior walls and the edges of ceilings with a 5 per cent. solution by weight of DDT in kerosene at 1–1·5 U.S. gals. per 1,000 sq. ft. gave complete or almost complete control of *Phlebotomus*, and no bites were reported by the occupants. Spraying the outside walls from ground to eaves including doors, windows and screens, and spraying only the outside of openings and a little of the surrounding wall both reduced sandfly populations to about 25 per cent. of those in control buildings, and very few bites were reported. Comparable results were obtained in experiments on a smaller scale at other places in the region. Effectiveness was undiminished during the 24 days of observation, and interrupted observations on the spraying of tents indicated that this may be as effective as the spraying of houses.

On the basis of these results, it is recommended that the inner walls and as much of the ceiling as possible should be sprayed to protect the occupants of buildings, particular attention being given to corners, upper parts of walls and doors, windows and screens, and that for greater protection the outside of openings and a foot or two of the surrounding wall should be sprayed also. Persons out-of-doors should use repellents and protective clothing. Where shelters and breeding places of *Phlebotomus* are very near buildings, outside spraying alone gives good control and treating of carefully selected outdoor surfaces might give local area control, protecting persons in the open as well as in buildings. An experiment along these lines carried out by S. Adler in northern Palestine indicated the practicability of the measure. The larvae, protected by soil and débris, would not be affected, but the adults would be destroyed on entering or leaving the breeding places.

Rice (P. L.), Huffaker (C. B.) & Back (R. C.). **DDT-Thanite Sprays for Mosquitoes.**—*Soap* **21** no. 3 pp. 119, 121, 146, 2 figs., 1 ref. New York, N.Y., 1945.

The effectiveness of sprays of DDT alone and in combination with Thanite (a terpene thiocyano ester) against adults (mostly females) of *Anopheles quadrimaculatus*, Say, was tested in Delaware in the laboratory and in the field. In the former, the sprays were atomised into a standard Peet-Grady chamber [216 cu. ft.] in doses of 6 ml., 50–100 mosquitos were exposed for 2½ minutes, and the percentages paralysed at the end of this time and dead after 24 hours were estimated. For field tests, the mosquitos were confined in batches of 50 in three cylindrical cans 3½ ins. high and 5 ins. in diameter with gauze ends, hung vertically on the wall of a cattle shed open on one side. The spray was discharged towards the wall under a pressure of 20 lb. at 6·5 ml. per 48 sq. ft. The cages were removed from the wall and aired rapidly 30 seconds after spraying began, and the percentage paralysis was estimated five minutes after exposure and mortality after 24 hours. Deodorised kerosene was the solvent in all cases. The average percentages of mosquitos paralysed and (in brackets) killed in four laboratory tests by 1 per cent. each of a pyrethrum preparation (Pyrethrol " 20 "), used for comparison, DDT and 1 : 4 and 2 : 3 combinations of DDT and Thanite were 97 (94), 57 (100), 92 (96) and 86 (99), respectively. The slowness of the effect of DDT indicated that combination with a substance causing rapid paralysis should be considered. Excellent kills were obtained with the same materials at half the concentration. In nine field experiments, 1·5 per cent. each of Pyrethrol " 20," and 1 : 4 and 2 : 3 combinations of DDT and Thanite gave 88, 86 and 84 per cent. paralysis, respectively, and 73, 94 and 98 per cent. kill.

Parker (W. V.) & Johnson (H. A.). **A universal Type Concrete Slab for precast Ditch Linings.**—*Publ. Hlth Rep.* **60** no. 21 pp. 582–587, 2 pls., 14 figs. Washington, D.C., 1945.

A description is given of a precast concrete slab for lining the ditches used to prevent the breeding of Anophelines in the southern United States [*cf. R.A.E.*, B **31** 216]. It is simple to construct, can be handled by one man, allows of great variety in the section of the ditch, and resists the penetration of vegetation through the joints. These are of the tongue-and-groove type. Each slab measures 12×24×2 ins. Eight slabs can be cast per man-hour, and 12–14 linear feet of lining should be laid per man-hour where the lining is three slabs wide. The methods of casting and laying the slabs are also described, and the cost of materials is given.

Papers noticed by Title only.

Floch (H.) & Abonnenc (E.). **Description d'un phlébotome nouveau** [*Phlebotomus guadeloupensis*, sp. n.] **de la Guadeloupe.**—*Publ. Inst. Pasteur Guyane* no. 96, 4 pp., 1 fig. Cayenne, 1945.

Stone (A.). **A new Species of** *Aëdes* [*saipanensis*, sp. n.] **from Saipan and the Larva of** *Aëdes pandani* **(Diptera : Culicidae).**—*Proc. ent. Soc. Wash.* **47** no. 3 pp. 65–69, 2 figs. Washington, D.C., 1945.

Merisuo (A. K.). **Notulae mallophagologicae. I** [including new records and lists of all the Finnish Mallophaga with their hosts]. [*In German.*]—*Ann. ent. fenn.* **10** no. 4 pp. 198–226, 6 figs., 37 refs. Helsinki, 1945.

Mooser (H.). **Die Beziehungen des murinen Fleckfiebers zum klassischen Fleckfieber.** [The Relations of Murine Typhus to Classical Typhus (a discussion of the literature).]—*Acta trop.* suppl. 4 [5+] 87 pp., 1 pl., 171 refs. Basle, 1945. (With Summaries in English and French.)

Hammon (W. McD.), Reeves (W. C.) & Galindo (P.). **Epizoölogy of Western Equine Type Encephalomyelitis : Eastern Nebraska Field Survey of 1943 with Isolation of the Virus from Mosquitoes.**—*Amer. J. vet. Res.* **6** no. 20 pp. 145–148, 20 refs. Chicago, Ill., 1945.

Studies in the Yakima valley, Washington, in 1941 and 1942 showed that the virus of western equine encephalomyelitis is transmitted principally by *Culex tarsalis*, Coq., and that the mosquitos acquire it mainly from domestic fowls [*R.A.E.*, B **33** 80, etc.]. In 1943, the virus was isolated 28 times from *C. tarsalis* and three times from other mosquitos, also in a hot, irrigated valley area, in south central California. An account is here given of a survey made in eastern Nebraska in 1943 to determine whether equine epizootics in dry farming country were also due to aberrations of a cycle of infection normally involving fowls and *C. tarsalis*, which is common even in mid-western States. More than 10,000 mosquitos of 10 or 11 species and 1,480 bed-bugs (*Cimex lectularius*, L.) were tested by animal inoculation, and the virus of western equine encephalomyelitis was isolated from one pool of 67 *C. tarsalis* out of 631 caught. All other results were negative. All the bugs were from fowl-houses. In neutralisation tests on the sera of 91 mammals and birds from eastern Nebraska, positive results were obtained with pheasants and horses for St. Louis encephalitis and with cows for western equine encephalomyelitis, and doubtful results with horses and cows for eastern equine encephalomyelitis and a cow for St. Louis encephalitis. All results with fowls and rabbits were negative. The fact that these and pheasants were negative for western equine encephalomyelitis suggests that the virus may be adapted to some other host in this locality.

Bishopp (F. C.) & Trembley (H. L.). **Distribution and Hosts of certain North American Ticks.**—*J. Parasit.* **31** no. 1 pp. 1–54, 18 maps, 61 refs. Lancaster, Pa., 1945.

Data, based on collections made by the U.S. Bureau of Entomology and Plant Quarantine over a period of 35 years, are given on the geographical and seasonal distribution and hosts in the United States of some 30 species of ticks. Notes on economic importance and general indications of distribution outside the United States are included for most species and occasionally a list of hosts in other countries. Hosts are referred to by their common names, and a list of their scientific names is appended.

Cantrell (W.) & Jordan (H. B.). **New Mosquito Hosts for** *Plasmodium gallinaceum*.—*J. Parasit.* **31** no. 1 pp. 55–56, 5 refs. Lancaster, Pa., 1945.

The mosquitos that had previously been infected with *Plasmodium gallinaceum* [*R.A.E.*, B **25** 121 ; **27** 176 ; **29** 195 ; **30** 191 ; **31** 170] included only three species indigenous to North America, *viz. Aëdes vexans*, Mg., *A. aegypti*, L., and *Culex fatigans*, Wied. (*quinquefasciatus*, auct.). In observations in which females of nine American species were fed on an infected bird and kept at 28°C. [82·4°F.], examples of *A. campestris*, D. & K., *A. stimulans*, Wlk., *A. triseriatus*, Say, *A. trivittatus*, Coq., *A. vexans*, *Culex salinarius*, Coq., *Mansonia perturbans*, Wlk., and *Theobaldia inornata*, Will., contained oöcysts when dissected 3–9 days later and sporozoites were found in the first three after 9–21 days. Only *C. pipiens*, L., of which 120 females were dissected, did not become infected. The greatest number of any other species dissected was 22.

Hu (S. M. K.). **Studies on the Susceptibility of Shanghai Mosquitoes to experimental Infection with** *Microfilaria malayi* **Brug. VII.** *Culex fuscanus* **Wiedemann.**—*Chin. med. J.* **62** no. 3 pp. 255–259, 6 refs. Washington, D.C., 1944.

Records are given of experiments, similar to others already noticed [*R.A.E.*, B **30** 84, etc.], carried out in 1939 and 1940 on the susceptibility of *Culex*

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fuscanus, Wied., to infection with *Filaria* (*Microfilaria*) *malayi*. Females reared from larvae collected near Shanghai were fed there on two infected persons from Chekiang Province. Of 64 fed on a case showing high microfilarial counts, two were later found to contain one mature filarial larva each, 14 contained dead encapsulated immature larvae, and 49 were negative. One of the mature larvae was dead, and both were partly encapsulated [*cf.* **27** 82]. A female of *Anopheles hyrcanus* var. *sinensis*, Wied., fed at the same time as the mosquito in which the dead mature larva was found was later seen to contain 38 active infective larvae. Four other females of *C. fuscanus* were negative after feeding on 23rd August 1939 on a man who showed a much lower microfilarial count but had infected 16 out of 17 females of *A. h. sinensis* fed on him on 4th August [**29** 93].

It is unlikely that *C. fuscanus* plays any significant part in the transmission of *F. malayi* in the lower Yangtze region, as it has seldom been seen to enter houses or feed on man there.

[Mandekos (A.) & Koukakes (M.).] **Malaria Control Work in Salonica.**—*Hellen. iatr.* repr. 11 pp., 2 refs. Thessalonica, 1939. (With a Summary in English.)

The following is taken from the authors' summary. A malaria survey made in and around the city of Salonica in April 1937 revealed spleen and parasite rates of 17·8 and 10 respectively in the city and 40·6 and 23 in nine surrounding communities. The vectors were races of *Anopheles maculipennis*, Mg., including var. *sacharovi*, Favr (*elutus*, Edw.) and *A. superpictus*, Grassi [*cf. R.A.E.*, B **26** 207]. A campaign for the control of the Anopheline vectors was begun in the summer of 1937 and continued in 1938. The chief measures used were drainage and application of Paris green by a modification of the dustless method [*R.A.E.*, B **24** 289] in which 3 parts by weight egg albumen in 150 parts tap water was added to a mixture of 1,000 parts Paris green and 2,000 parts kerosene and the mixture diluted with 400 parts by volume of water from the breeding place. This method was very satisfactory and economical. The average numbers of adults of the Anopheline vectors caught per station in the entire season in 1937 and 1938 were 85·4 and 41·4 in protected places and 794 and 1,194 in unprotected ones, and the spleen and parasite rates had fallen by December 1938 to 7·4 and 2·3 in the city and 18·8 and 7·6 in the other communities. The spleen and parasite rates in Macedonia and Thrace as a whole rose during 1937. The total death rate and death rate through malaria fell considerably in the protected area in 1938. The cost of the measures is given.

Nicolle (P.) & Lwoff (M.). **Thermotropisme et alimentation artificielle des Réduvidés hémophages.**—*C. R. Soc. Biol.* **138** no. 5–6 pp. 164–165, 3 refs. Paris, 1944.

Lwoff (M.) & Nicolle (P.). **Alimentation artificielle de** *Triatoma infestans* **(Réduvidé hémophage) à l'aide de sérum vitaminé.**—*T. c.* no. 7–8 pp. 205–206, 5 refs.

Nicolle (P.) & Lwoff (M.). **L'acide pantothénique dans la nutrition de l'Hémiptère hémophage** *Triatoma infestans* **Klug.**—*T. c.* no. 11–12 pp. 341–343, 1 graph, 10 refs.

Previous work had shown that Triatomine bugs are guided to a host by thermotropism [*R.A.E.*, B **31** 6] and that, if physical conditions are suitable, they will engorge through a membrane on a liquid of the temperature of the normal host [**33** 11]. It is recorded in the first paper that the bugs can be induced by thermal stimulus alone to ingest enough food to develop to the adult stage. Several individuals of *Triatoma infestans*, Klug, completed development when fed twice a week by means of Nicolle's apparatus [**30** 178] on haemolysed rabbit blood [*cf.* **33** 62] or on horse serum supplemented with

unspecified vitamins. They were kept at 26°C. [78·8°F.] and 70–80 per cent. relative humidity. Development took 8–10 months compared with 5½ months for individuals fed on guineapigs. Weights were near normal when haemolysed blood was used, but often lower when the food supplied was vitaminised serum.

The second and third papers deal with the effect on the development of *T. infestans* of specified vitamins added to horse serum and glucose [*cf.* **33** 93]. Adults that fed, paired and laid fertile eggs were obtained only when pantothenic acid was included.

[Pavlovskiĭ (E. N.) & Solov'ev (V. D.).] **Павловский (Е. Н.) и Соловьев (В. Д.). On the Circulation of the Virus of Spring-Summer Encephalitis in the Body of the Tick Vector,** *Haemaphysalis concinna*. [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **25** pp. 9–18, 3 figs., 1 ref. Leningrad, 1941. (With a Summary in English.)

Following the discovery that *Haemaphysalis concinna*, Koch, is a vector of the virus of spring-summer encephalitis in the Russian Far East [*cf. R.A.E.*, B **31** 70], experiments were carried out in the Province of Khabarovsk in 1938 to ascertain the distribution of the virus in the body of the tick [*cf.* **27** 239]. For this purpose, starved females of *H. concinna* taken with muslin drags and partly engorged females taken on cattle were allowed to feed for three and four days, respectively, on mice artificially infected with a strain of the virus from man. This resulted in partial engorgement of the ticks from the drags and complete engorgement of the others. The ticks were dissected 3–6 days later and suspensions of various organs were injected into the brains of healthy mice. The virus is referred to as apparent when these mice developed typical symptoms of the disease, and as inapparent when its presence was shown only by subsequent subinoculation. The virus was shown to persist in the intestine of the ticks for six days, which is thought not to represent the limit. In the partly engorged ticks, it occurred only in the inapparent form and was demonstrated only in the intestine and the salivary glands. In the engorged ticks, it occurred in the apparent form in the intestine and the salivary glands and in the inapparent form in the haemolymph, the Malpighian tubes, the genitalia, Gené's organ and the central nervous system.

[Levkovich (E. N.).] **Левкович (Е. Н.). Serological Blood Characteristics of the Population in the endemic Region of Tick-borne (Spring-Summer) Encephalitis.** [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **25** pp. 19–22. Leningrad, 1941. (With a Summary in English.)

[Levkovich (E. N.) & Skruinnik (A. N.).] **Левкович (Е. Н.) и Скрынник (А. Н.). Experimental Analysis of the Mechanism of natural Immunisation of the Population in the Foci of Tick-borne (Spring-Summer) Encephalitis.** [*In Russian.*]—*T.c.* pp. 23–26, 2 refs. (With a Summary in English.)

Observations in the Russian Far East have shown that the prevalence of spring-summer encephalitis in endemic foci and the mortality caused vary inversely with the length of time that the inhabitants have been settled in them. To ascertain whether this is due to a gradually acquired immunity [*cf. R.A.E.*, B **31** 70], serological tests of the population from areas in the forest, some of which had been cleared, were carried out in 1937 and 1938, and are discussed in the first paper. The results showed that about a third of a group of local inhabitants who had not suffered from the disease possessed protective antibodies in their blood, as compared with a negligible proportion among the medical staff and other newly arrived persons. It is concluded that a latent immunisation of the population takes place irrespective of their contact with cases of encephalitis, and that it is acquired in the forest through the bites of naturally infected ticks.

The part played by ticks in such natural immunisation was confirmed by the experiments described in the second paper. They were carried out in May 1939 with adult females of *Ixodes persulcatus*, Schulze, that had fed for two days on mice artificially infected with a human strain of the virus and nymphs of *Haemaphysalis concinna*, Koch, and adults of *Dermacentor silvarum*, Olen., that had acquired the virus in the larval and nymphal stages, respectively, in 1938. From one to six ticks were allowed to feed for three or six days on healthy mice, and the resistance of the latter was then tested by injecting into them 2, 5 or 25 minimum lethal doses of the virus. Some of the mice proved to be resistant to infection, even with the highest dosage, and their blood was found to contain antibodies that rendered the virus inactive. The degree of immunity varied with the number of ticks used per mouse and the duration of feeding.

[Ruizhov (N. V.) & Skruinnik (A. N.).] **Рыжов (Н. В.) и Скрынник (А. Н.). On the natural Infection of Ticks of the Family Ixodidae with the Virus of Spring-Summer Encephalitis.** [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **25** pp. 27–33, 1 ref. Leningrad, 1941. (With a Summary in English.)

In the experiments described, which were carried out in an endemic focus of spring-summer encephalitis in the Province of Khabarovsk (Russian Far East) in the summer of 1938, 208 examples of *Dermacentor silvarum*, Olen., 91 of *Ixodes persulcatus*, Schulze, and 125 of *Haemaphysalis concinna*, Koch, taken on muslin drags in the forest or from domestic animals, rodents and birds, failed to transmit infection to healthy mice on which they were allowed to feed in batches for 1–72 hours, but when suspensions of batches of ticks were injected intracerebrally into mice, two strains of the virus were isolated from adults of *I. persulcatus*, three from nymphs of this tick, one from adults of *H. concinna* and one from a mixed batch of adults and nymphs of *I. persulcatus* and a single adult of *H. concinna* [*cf. R.A.E.*, B **28** 66]. The strains were shown by serological investigation to be identical with human spring-summer encephalitis and with the virus isolated by the senior author in 1937 [*cf.* **27** 240]. Of the infected ticks, the adults of *Ixodes* were collected by means of drags, the nymphs from a chipmunk (*Eutamias sibiricus*), a squirrel (*Sciurus vulgaris*) and a thrush (*Turdus hortulorum*), the adults of *Haemaphysalis* from a dog, and the mixed batch from a hare (*Lepus timidus*). A similar test with a batch of adults of *D. silvarum* gave negative results, but it is considered that this tick should not therefore be ignored in further investigations on the vectors of encephalitis [*cf.* **27** 240].

[Ruizhov (N. V.) & Kozlova (A. V.).] **Рыжов (Н. В.) и Козлова (А. В.). The natural Infection of Ixodid Ticks by the Virus of Spring-Summer Encephalitis in the Taïga Region of the Ussuri Land.** [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **25** pp. 34–40, 2 refs. Leningrad, 1941. (With a Summary in English.)

In connection with investigations on spring-summer encephalitis in the south of the Province of Ussuri (Russian Far East) in 1939, nearly 5,000 ticks were collected with muslin drags and from cows, squirrels (*Sciurus vulgaris*) and chipmunks (*Eutamias sibiricus*) in various forest regions. They comprised *Ixodes persulcatus*, Schulze, which was by far the commonest, *Haemaphysalis concinna*, Koch, *H. japonica*, Nutt. & Warb., and *Dermacentor silvarum*, Olen. In tests for natural infection with the virus, none was found in ticks of any species taken in an inhabited forest area, but three strains were isolated from females of *I. persulcatus* that had been taken on drags in a remote forest reserve and allowed to feed on laboratory mice, 19 from males and females of *I. persulcatus* taken on drags and four from nymphs taken from *Eutamias* and *Sciurus*, suspensions of which were injected into mice, and one from adults of *D.*

silvarum taken on drags, also by injection of a suspension. No infection was found in *Haemaphysalis* spp.

[Skruinnik (A. N.) & Ruizhov (N. V.).] **Скрынник (А. Н.) и Рыжов (Н. В.). Experimental Investigation on the Ticks, *Dermacentor silvarum* Ol., as the Vectors of Spring-Summer Encephalitis.** [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **25** pp. 41–49, 2 figs., 12 refs. Leningrad, 1941. (With a Summary in English.)

A detailed account is given of the experiments in the Province of Khabarovsk (Russian Far East) in 1937–38 in which it was shown that the virus of spring-summer encephalitis persists in *Dermacentor silvarum*, Olen., from stage to stage and from generation to generation [*R.A.E.*, B **27** 239, 240]. *D. silvarum*, *Haemaphysalis concinna*, Koch, and *Ixodes persulcatus*, Schulze, represented 50, 37 and 13 per cent., respectively, of the ticks on cattle, 65, 28 and 7 per cent. of those on horses, 0·5, 79·5 and 20 per cent. of those on dogs, and 8, 12 and 80 per cent. of those collected from muslin drags and clothing. *D. silvarum* was most abundant in the second half of May and almost disappeared at the beginning of July.

[Kozlova (A. V.) & Solov'ev (V. D.).] **Козлова (А. В.) и Соловьев (В. Д.). Experimental Study of the Tick, *Haemaphysalis concinna*, as Vector of the Virus of Spring-Summer Encephalitis.** [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **25** pp. 50–57, 8 refs. Leningrad, 1941. (With a Summary in English.)

In the course of observations on *Haemaphysalis concinna*, Koch, in the Province of Khabarovsk in 1938 and 1939, considerable numbers of this tick were taken on cows, horses and particularly dogs, at the end of May and the beginning of June, which is the period during which cases of spring-summer encephalitis occur. Larvae and nymphs were collected from squirrels (*Sciurus vulgaris*) and chipmunks (*Eutamias sibiricus*) and several nymphs were found attached to the authors in July. The tick was bred in the laboratory at 15–27°C. [59–80·6°F.] to obtain a stock for experimental purposes, and it was found that the females oviposited 4–19 days after the completion of feeding. The larvae hatched in 26–30 days, and the larval and nymphal stages lasted 16–23 and 36–55 days, respectively, after feeding.

In experiments on transmission in which 13 batches of adult females were allowed to feed for 2–120 hours on mice infected with the virus of encephalitis and transferred to healthy mice 5–35 days later for the completion of the meal, one batch of seven ticks that had fed for four days transmitted the infection 21 days later, and, in further tests, it was transmitted by the injection of suspensions of batches of ticks 1–23 days after the infecting feed. No infection resulted from the injection into healthy mice of suspensions of the eggs, larvae or nymphs derived from females that had fed on infected mice for 1–5 days and completed their meal on a healthy rabbit, or from the feeding of larvae, but nymphs from the latter transmitted the virus in two instances to mice on which they fed. Ticks that acquired the virus in the larval and nymphal stages by feeding on infected mice transmitted it in the nymphal and adult stages, respectively, when fed on healthy mice [*cf. R.A.E.*, B **31** 70].

[Levkovich (E. N.) & Gutzevich (A. V.).] **Левкович (Е. Н.) и Гуцевич (А. В.). Experimental Investigation of Mosquitos (*Aëdes*) as Vectors of the Virus of Spring-Summer (Tick-borne) Encephalitis.** [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **25** pp. 58–64, 9 refs. Leningrad, 1941. (With a Summary in English.)

The authors review from the literature the results of investigations on the part played by mosquitos in the transmission of St. Louis encephalitis [*cf.*

R.A.E., B **32** 129, etc.] and Japanese epidemic encephalitis [**31** 2, 3] and give an account of work in the Province of Khabarovsk (Russian Far East) in 1938 to ascertain whether the mosquitos that are common there can harbour and transmit the virus of spring-summer (tick-borne) encephalitis. The seasonal incidence of the disease does not coincide with the maximum abundance of mosquitos [*cf.* **27** 70], but they are very common in the endemic regions. The two tested were *Aëdes vexans* var. *nipponii*, Theo., and *A. excrucians*, Wlk.

Females of both species taken in nature were allowed to feed for 20 minutes on patients in the first three days of the disease and kept at 25°C. [77°F.] for 3–14 days. Suspensions of them were then injected intracerebrally into laboratory mice, but the results were negative. It was shown by further tests, in which suspensions of known strength were injected, that the virus persisted for five but not ten days in adults of var. *nipponii* that had fed on infected mice and were then kept at 20–34°C. [68–93·2°F.] and fed on sugar solution, and that its concentration had declined considerably after four hours. *A. excrucians* gave negative results in similar tests, and no symptoms were produced in mice by the bites of adults of both mosquitos that had fed 6–10 days previously on infected mice. Subinoculations also proved negative.

It is concluded that the virus cannot persist long or increase in these two mosquitos or be transmitted by them.

[Pis'yaukova (V. V.).] **Письякова (В. В.). A Study of botanical Characteristics of the Habitats of Ticks—Vectors of the Tick-borne Encephalitis.** [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **25** pp. 65–80, 19 refs. Leningrad, 1941. (With a Summary in English.)

[Solov'ev (V. D.).] **Соловьев (В. Д.). On the Reservoir of the Virus of Spring-Summer Encephalitis in natural Conditions.** [*In Russian.*]—*T.c.* pp. 95–111, 5 figs. (With a Summary in English.)

In the first of these papers, the results are given of a botanical survey made in 1939 in a district in the valley of the Amur (Russian Far East) north of Khabarovsk with the object of ascertaining what plant communities provide favourable conditions for the ticks, *Ixodes persulcatus*, Schulze, *Haemaphysalis concinna*, Koch, and *Dermacentor silvarum*, Olen., that transmit spring-summer encephalitis. The area consisted of mixed coniferous and deciduous forest, meadows and swamps, and ticks were most abundant in mixed forest of pine and broad-leaved trees of the mesophytic type, with a dense and varied undergrowth affording food such as nuts and berries for their natural hosts. They were favoured by sufficient though not excessive soil humidity and well drained soil that does not freeze in winter.

In the second paper, an account is given of investigations carried out in 1939 in the south of the Province of Ussuri to ascertain which animals serve as reservoirs of the virus of spring-summer encephalitis. The main results have been noticed in a previous abstract [*R.A.E.*, B **31** 70].

[Pervomaĭskiĭ (G. S.).] **Первомайский (Г. С.). An Experiment on the Control of the Ixodid Ticks in a Focus of Encephalitis.** [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **25** pp. 81–94, 3 figs., 6 refs. Leningrad, 1941. (With a Summary in English.)

Collections of ticks in endemic foci of spring-summer encephalitis in the Russian Far East have shown that *Dermacentor silvarum*, Olen., becomes active when the snow melts and is rare after 10th May in the south, whereas *Ixodes persulcatus*, Schulze, *Haemaphysalis concinna*, Koch, and *H. japonica*, Nutt. & Warb., are commonest from 20th May to 10th June. In the Province of

Ussuri in 1939, ticks were far more abundant in undisturbed parts of the forest than in those that adjoined settlements ; *I. persulcatus*, *Haemaphysalis* and *D. silvarum* represented 87·5, 12 and 0·5 per cent. of those taken on man.

Investigations in an endemic focus north of Khabarovsk in 1938–39 showed that the inhabitants were best protected from ticks by wearing overalls fitting tightly at the wrists and having a closely fitting hood covering the ears and the lower part of the chin, but some protection was afforded when ordinary clothing was made to fit tightly at the neck, wrists and waist and top-boots were worn. More ticks crawled on to rough materials than on to smooth. Precautionary measures comprise frequent examination of the body and clothing for ticks, which should not be crushed since they may contain the virus in their bodies, and regular disinfestation of dogs and other domestic animals. The use of these measures in settlements of which a large part of the population worked daily in the forest greatly reduced or eliminated the disease in 1939. In tests of various repellents that had shown promise in the laboratory, little protection was given by impregnating clothing with a mixture of 10 per cent. lysol and 5 per cent. turpentine in water, 1–1·5 per cent. of the preparation K [dixanthogen] emulsified in water by means of soap, or a 1·5 per cent. solution of polychlorides [a mixture of chlor- and dichlorbenzenes], though the crawling of *I. persulcatus* on the impregnated garments was considerably slower and about half the ticks of the genus *Haemaphysalis* eventually dropped off. It is stated in a footnote that higher concentrations of the preparation K gave better results in 1940.

The possibility of destroying ticks in the forest was studied in 1938 by spraying examples confined within wooden frames about a yard square on the ground. The ticks moved very slowly, and reliable results could be obtained in about half an hour. Several sprays gave complete mortality of ticks of all three genera, the most practicable including 5 per cent. lysol and 2 per cent. phenol. The effectiveness of these sprays was confirmed in experiments on larger plots under natural conditions in the forest, but in a further experiment in the spring of 1939, it was found that the lysol spray remained effective for only ten days, the numbers of ticks on sprayed plots being subsequently as great as on unsprayed ones. The sprays may be useful, however, for treating small areas prior to human habitation, for clearing protective zones round inhabited areas and for freeing paths from ticks.

[Petrova-Piontkovskaya (S. P.).] **Петрова-Пионтковская (С. П.). On the Biology of the Tick, *Dermacentor nuttalli*, as the Transmitter of the spotted Tick-Fever.** [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **25** pp. 122–134, 13 figs. Leningrad, 1941. (With a Summary in English.)

Experiments are briefly reviewed showing that *Dermacentor nuttalli*, Olen., is a vector of the spotted fever (tick-typhus) that is endemic in south-central Siberia [*cf. R.A.E.*, B **32** 220, etc.] and that the causal agent persists in the tick from stage to stage and from generation to generation [*cf.* **32** 221]. An investigation in 1938 in an area near the upper Yenisei, where the steppe is used for grazing cattle, showed that the disease occurred chiefly in spring among people who frequented the steppe, and that all cases had a history of tick-bite. Field observations during May and June showed that *D. nuttalli* was the commonest tick on cattle ; it also occurred on sheep and often attacked man. Larvae were taken on ground-squirrels (*Citellus eversmani*) and voles (*Microtus* sp.) [*cf.* **32** 221] but not on other wild rodents or in the burrows of rodents. The tick was absent from areas under forest, lowlands near rivers, and hilly wooded country, and such districts were also free from the disease.

D. nuttalli was bred in the laboratory mainly at temperatures between 17 and 25°C. [62·6–77°F.]. Males and females that fed in May on rabbits or guineapigs became engorged in 5–17 and 5–13 days, respectively ; the females oviposited 4 days after abandoning the hosts, continued to do so on the average for 21 days and survived for 35–50 days. The larvae hatched in an average of 24 days and attached themselves to laboratory animals 3–4 days later. They fed for 2–8 days and most of them then dropped off and moulted after 5–8, but a few moulted on the host and the resulting nymphs remained on it to feed. The other nymphs attached themselves to fresh hosts 3–4 days after moulting, fed for 5·5–7 days and gave rise to adults 11–12, 20–25 and 51–73 days later at 24·2, 18·2 and 10-13°C. [75·6, 64·8 and 50–55·4°F.], respectively. There is apparently only one generation a year, and the adults that appear in autumn do not seem to feed then or in winter.

[Serdyukova (G. V.).] **Сердюкова (Г. В.). On the Rôle played by Ticks of the Family Ixodidae in the Transmission of the Relapsing Fever Spirochaetae.** [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **25** pp. 135–144, 1 fig., 11 refs. Leningrad, 1941. (With a Summary in English.)

In the experiments described, it was shown by injection into healthy guineapigs of suspensions of adult ticks that had fed on guineapigs infected with the Stalinabad strain of relapsing fever that *Rhipicephalus bursa*, C. & F., retains the spirochaete for not more than four days after the infecting feed, and *Dermacentor pictus*, Hermann, *D. marginatus*, Sulz., *Hyalomma anatolicum excavatum*, Koch, and *H. marginatum*, Koch, for not more than 24 hours. The spirochaete was not transmitted to animals on which adults of *H. marginatum* and *D. marginatus* completed their meal after having partly engorged on infected guineapigs, and in further experiments, it was shown by feeding and by injection of suspensions of various stages of these two ticks and *R. bursa* that infection does not pass to the progeny of females given an infecting feed.

[Pospelova-Shtrom (M. V.).] **Поспелова-Штром (М. В.). On the vertical-zonal Distribution of some Ticks of the Genus *Ornithodorus* in Turkmenia.** [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **25** pp. 145–152, 3 figs., 10 refs. Leningrad, 1941. (With a Summary in English.)

A survey is given of the distribution of *Ornithodoros tholozani*, Lab. & Mégn. (*papillipes*, Bir.), *O. tartakovskyi*, Olen., and *O. nereensis*, Pavl., at successive altitudes in the south-western and southern parts of Turkmenistan, based on observations by the author and others in 1935 and 1936. Each species appeared to be associated with particular habitats [*cf. R.A.E.*, B **31** 161], and none of them occurred in the lowlands at or below sea level, where the soil was frequently wet.

O. tartakovskyi was rare in the desert plain at altitudes of up to about 1,000 ft., but was abundant in dry waste land, ravines and cemeteries in the cultivated zones in the river valleys, and still more so in undulating foot-hills of a desert-steppe character with a dry continental climate at altitudes of 1,000–1,650 ft., in which the gerbille, *Rhombomys opimus*, and the ground squirrel, *Spermophilopsis leptodactylus*, are common. In summer, the ticks congregated in the front part of the burrows, where the temperature was almost always 27°C. [80·6°F.] ; this appears to be the optimum temperature for *O. tartakovskyi*, and in the laboratory it proved favourable for oviposition and hatching. Excessive humidity was detrimental, and the ticks left the front part of the burrows after heavy rain. *O. nereensis* was restricted to the Karakala region [*cf.* **32** 70], where it occurred in the cultivated irrigated zone and in undulating foot-hills, but was commonest in fairly damp lands at the foot of the mountain-steppe zone at an altitude of 1,650–4,600 ft. The burrows inhabited by it were

similar in temperature and humidity to those in which *O. tartakovskyi* occurred. *O. tholozani* was scarce in the cultivated zone, but common at altitudes of 1,000–6,560 ft. It was found in the hotter zones in caves and the burrows of porcupines, which are comparatively cool, and in the colder and more humid zones in smaller burrows, the microclimate of which differs little from that obtaining outside. In caves, the parts inhabited by the ticks were damp and had a temperature of only 18–22°C. [64·4–71·6°F.], the conditions resembling those in human dwellings, but this tick is resistant to changes in temperature and humidity.

Observations by the author in Tadzhikistan, the Pamir plateau and southern Kirghizia have given similar results, so that it is thought that the conclusions are applicable to the whole of Central Asia.

[Gutzevich (A. V.).] **Гуцевич (А. В.). On the Bloodsucking Diptera in the southern Part of the Ussuri Land (the Far-East of the USSR).** [*In Russian.*] —*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **25** pp. 161–175, 2 figs., 12 refs. Leningrad, 1941. (With a Summary in English.)

A survey of blood-sucking Diptera similar in method to previous ones [*R.A.E.*, B **33** 185; **34** 41] was carried out in May–July 1939 in a partly cultivated valley in the south of the Province of Ussuri, and the results are shown in tables and discussed. In all, 52 species were recorded. Those taken attacking man comprised three Simuliids, four Ceratopogonids, 12 Tabanids, ten species of *Aëdes* and *Culiseta* (*Theobaldia*) *borealis*, Shing. *A. punctor*, Kby., other mosquitos and the Ceratopogonid, *Culicoides obsoletus*, Mg., constituted about 44, 26 and 24 per cent., respectively, of the insects taken on man.

The seasonal occurrence and breeding places of the mosquitos are discussed. The majority (including *A. punctor*) bred in small shaded pools of cold water fed by springs in forests. The coldness of the water, of which the maximum temperature was usually 15–17°C. [59–62·6°F.] but occasionally ranged up to 19°C. [66·2°F.], retarded the development of the larvae, so that the adults emerged rather late and mass attacks on man did not occur before 15th June. The only Anopheline present was *Anopheles hyrcanus*, Pall., which did not attack man and was scarce, probably owing to the lack of breeding places with sufficiently warm water. Larvae and pupae were found in a fairly large depression in which the water was exposed to the sun and had a temperature of 20–25°C. [68–77°F.] in May June and 25–33°C. [77–91·4°F.] in July. There were two generations, the adults of the first emerging chiefly in the first ten days of June and those of the second from 5th July onwards. The author points out that these dates are typical for the southern part of the Province of Ussuri and that his previous record of the appearance of first-generation adults of *A. hyrcanus* about 20th July [**33** 184] should refer to adults of the second generation.

In some places in the forest and on the hills, Ceratopogonids were the most numerous of the Diptera taken on man. *C. obsoletus* was commonest from about 10th May until mid-July and was particularly active in the first ten days of June.

[Olsufev (N. G.).] **Олсуфьев (Н. Г.). New experimental Data on the Rôle of Mosquitoes in the Transmission and Preservation of the Tularemia Infection.** [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **25** pp. 176–189, 1 ref. Leningrad, 1941. (With a Summary in English.)

Laboratory investigations on the transmission of tularaemia by mosquitos in the Russian Union [*cf. R.A.E.*, B **27** 241] were continued in 1936. The mosquitos were allowed to feed on artificially infected rodents, mostly water voles [*Arvicola amphibius*], and were then transferred to healthy guineapigs either immediately or after intervals of 1–35 days. The number of mosquitos

used for a test ranged from 1 to 14 but was usually 3–4, and the number of bites per animal was usually 6–10, but ranged from 1 to 23. Transmission occurred in 21 tests out of 55. No results were obtained in one test with *Anopheles maculipennis*, Mg., four with *Culex modestus*, Fic., or one with *Aëdes caspius*, Pall., but the infection was transmitted by *Mansonia richiardii*, Fic., *A. flavescens*, Müll. (*lutescens*, F.) and two varieties of *A. vexans*, Mg. These were *nipponii*, Theo., and *bactrianus*, n.; it is stated in a footnote that the latter can be distinguished from var. *nipponii* by its smaller size and brighter coloration and is to be described more fully elsewhere. *A. flavescens* and *M. richiardii* were more efficient in transmission than the other mosquitos, in which the proboscis is smaller, and the proportion of positive transmissions was greater when the voles showed high bacteraemia. After an infective feed on such animals, *A. flavescens* transmitted the bacterium for up to 16 days, *A. v. bactrianus* for up to 27 days, *A. v. nipponii* for up to 2 days and *M. richiardii* for up to 11 days, but one batch of *M. richiardii* fed on a vole with lower bacteraemia transmitted it after 14 days. Fatal infections were caused in mice by only one or two bites, and the same batch of mosquitos infected two guineapigs successively at intervals of a few days. Infection was produced in guineapigs whether or not the mosquitos ingested blood at the time of the attack, and transmission was found to be purely mechanical.

In further experiments, 7 of 15 guineapigs contracted the disease and died within 7–20 days when mosquitos deprived of their legs and wings were crushed on the skin 2½–16 days after an infective feed, the skin being scarified as they were rubbed in. Injections into mice of suspensions of mosquitos that had fed on healthy guineapigs following an initial infective feed gave positive results in 41 of 56 tests, and it was thus shown that the bacterium can be preserved in mosquitos for 35 days, though the percentage of positive cases decreased as the interval between the two feeds became longer. Some of the positive results were obtained from suspensions of mosquitos that had failed to effect transmission by bite.

Subcutaneous injections into mice of suspensions of the excreta of *M. richiardii* and *A. flavescens* that had fed up to 20 days previously on voles with high bacteraemia showed that the bacteria were present in them for up to 8 and 14 days, respectively. As supplementary feeding of the mosquitos on fresh blood did not prolong these periods, it is concluded that the bacterium does not multiply in the stomach. It is suggested, however, that since mosquitos excrete copiously after feeding, they may disseminate it in this way. No infection resulted from injections of suspensions of eggs laid by females of *A. v. bactrianus* 6–23 days after feeding on a vole with high bacteraemia, though suspensions of the mosquitos themselves produced the disease in mice.

[Olsuf'ev (N. G.).] **Олсуфьев (Н. Г.). The Rôle of Mosquitoes in transmitting Tularemia Infection to wild Rodents, Birds and domestic Animals.** [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **25** pp. 190–197, 1 graph. Leningrad, 1941. (With a Summary in English.)

Laboratory observations in the summer of 1936 in south-eastern Kazakstan showed that species of *Aëdes* and *Culex* can feed successfully on healthy water voles (*Arvicola amphibius*), in spite of the great agility of these animals, and *Mansonia richiardii*, Fic., and species of *Aëdes*, *Culex* and *Anopheles* eagerly attacked various rodents that were more or less inactive because they were suffering from tularaemia, the rodents concerned being *Arvicola amphibius*, *Ellobius talpinus*, *Microtus iloeus* and *Rhombomys opimus*. The mosquitos fed on the carcasses of voles that had died up to two hours previously, but not those that were stiff and cold.

In experiments in which mosquitos were allowed to feed on infected rodents, generally *A. amphibius*, an hour or two before or after death and then transferred to healthy animals, usually within about three days, single examples of

Aëdes vexans vars. *nipponii*, Theo., and *bactrianus*, Olsuf'ev, transmitted fatal infections to *Arvicola amphibius* and *M. iloeus*, and batches of 3–6 to *R. opimus* and hares (*Lepus tolai*). One hare that was bitten by two females of *Anopheles hyrcanus*, Pall., showed symptoms but recovered, as also did a ground squirrel (*Citellus fulvus*) bitten by eight of *A. flavescens*, Müll. (*lutescens*, F.) and three marmots (*Marmota baibacina*) bitten by 3–10 of *A. v. bactrianus*. The birds, *Coturnix coturnix* and *Alectoris kakelik*, were not infected by the bites of *Mansonia richiardii* and *A. v. bactrianus*, respectively. In similar experiments with domestic animals, four sheep were infected by batches of four and 30 examples of *Aëdes vexans* var. *bactrianus* and ten and 30 of var. *nipponii*, though they eventually recovered, but a fifth sheep and a pig were not infected by six females of var. *nipponii* and 11 of var. *bactrianus*, respectively. The periods between feeds in the positive cases were $1\frac{1}{2}$–$6\frac{1}{2}$ days.

[Naumov (K. G.).] **Наумов (К. Г.). A Mass Investigation and Struggle against Mosquito Hibernations in the Chuisk Valley of the Kirghiz SSR.** [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **25** pp. 198–215, 7 figs., 21 refs. Leningrad, 1941. (With a Summary in English.)

The author reviews divergent opinions of Russian workers on the value as an anti-malaria measure of the destruction of hibernating Anophelines, and gives an account of a campaign carried out with this object in the winters of 1935–36 and 1936–37 in the valley of the Chu in northern Kirghizia, where *Anopheles maculipennis* var. *messeae*, Flni. [*cf. R.A.E.*, B **33** 38, 40] is the chief vector of malaria.

In all, nearly 45,000 potential hibernation places were surveyed in the first winter and nearly 74,000 in the second, and 6·7 and 8·37 per cent., respectively, were found to harbour mosquitos, particularly those that were situated near breeding places. The numbers of mosquitos taken in the two years in the many different types of shelters are shown in tables. Their occurrence depended much on temperature and they were commonest in basements and cellars in which the temperature averaged 6°C. [42·8°F.] ; 62·4 per cent. of such premises were infested in 1935 and 84·13 per cent. in 1936. The mosquitos were found on the walls and ceilings, in dark places behind beams and on cobwebs. They were also abundant in underground storerooms in which vegetables were kept, but did not occur in cellars flooded by ground water. Of the inhabited houses examined, only 10·53 per cent. were infested in 1935 and 2·7 per cent. in 1936, though the average temperatures in them ranged from 9 to 17°C. [48·2–62·6°F.], and the mosquitos found in them usually contained no blood. Of the closed sheds and disused half-ruined houses, 8·1 and 7·3 per cent. were infested in 1935, chiefly in the rice-field zone, and fewer in 1936. Very few garrets, barns, stables, cowsheds or pigsties harboured mosquitos ; the average temperature in them was low (from −4·5 to −8°C. [23·9–17·6°F.]).

There was little or no mortality among mosquitos hibernating in cellars and similar shelters. No malaria parasites were found in the 1,000 hibernating females of *A. m. messeae* that were dissected, and the primary cases of infection that are recorded in March and April may be due to slow incubation in man.

A survey of possible natural hibernation quarters, such as caves, pits and burrows, showed that only 2·53 per cent. of them harboured mosquitos in winter ; these were mostly the burrows of rodents, in which the temperature ranged from −2 to −7°C. [28·4–19·4°F.], and caves. Hibernating mosquitos were also found in haywicks, particularly on the side exposed to the sun. Such natural shelters were of little importance, however, since only 0·2 per cent. of all the hibernating mosquitos found occurred in them. The principal hibernation quarters of *A. hyrcanus*, Pall., were not discovered, but a few individuals occurred in a stable and in an open shed. Hibernating larvae of *A. claviger*, Mg.

(*bifurcatus*, auct.) were found under snow and ice in December 1935 in one of the numerous small swamps fed by springs.

The control measures adopted consisted in fumigating cellars by burning tobacco dust at the rate of 3–4 oz. per 100 cu. ft. for several hours and destroying the mosquitos that fell to the floor; brushing mosquitos from the walls and ceilings with a wet broom, catching mosquitos in living rooms, if not too numerous, by means of test tubes, and brushing animal quarters with a broom wetted with a 10 per cent. emulsion of kerosene. These measures freed the premises treated from mosquitos for the rest of the winter, and there was no inward migration from other places, although conditions were favourable for flight. Observations at certain representative places in 1936 showed that a marked reduction in the numbers of overwintered mosquitos resulted and there was no appreciable increase in the mosquito population even after the emergence of the adults of the first generation. Larvae were much less abundant in various breeding places in May, June and July 1936 than they had been during the same months in 1935, when no winter control measures had been carried out. There was also a reduction of 50 per cent. in the number of cases of malaria in the valley in 1936 as compared with 1935, and this is attributed partly to the destruction of hibernating mosquitos, though medical treatment of the population and dusting from aircraft against the larvae also contributed.

[Naumov (K. G.).] **Наумов (К. Г.). On the Possibility of burning Rice by Dusting it with Paris Green and Oleoarsenite.** [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **25** pp. 216–228, 2 pls., 10 refs. Leningrad, 1941. (With a Summary in English.)

In view of the risk of scorching rice by dusting rice-fields with arsenicals against Anopheline larvae [*cf. R.A.E.*, B **25** 113; **26** 171], field experiments were carried out in August and September 1936 in the valley of the Chu in northern Kirghizia with Paris green and oleoarsenite [a 1 : 4 mixture of calcium arsenite and oleogumbrin (*cf.* **25** 68)] mixed with road dust and applied from hand apparatus. The dusting was carried out in the morning and evening, and the treated plots were examined four days later.

Paris green (containing 54·86 per cent. As_2O_3 and 3·52 per cent. free As_2O_3) was tested at rates of approximately 5, 11, 14, 36 and 63 oz. per acre, the highest rate, which was the only one that scorched the plants before they had reached the flowering stage, being used to obtain a standard of injury for comparison. The lowest dosage, which is that usually applied in dusting from aircraft, caused no injury at any time, but the others caused some to rice in the phases of flowering and milky ripeness. It was slight at the 11-oz. rate, but more severe at higher rates, particularly on rice in flower. Injury was increased if the plants were wet with rain or dew, and dusting should not be carried out at such times. The injury at the intermediate rates of application is thought to have been due to the high content of free As_2O_3 in the Paris green, which exceeded the officially recommended limits.

Oleoarsenite (containing 12·19 per cent. As_2O_3) was tested in September, when the rice was in the phase of milky ripeness. It caused slight scorching, though the subsequent development of the plants was not impeded, at the rate of 11 oz. per acre in road dust and considerable injury when applied undiluted at 14 and 28 oz. In the phase of wax ripeness, the leaves and internodes of some of the plants were injured by a dosage of 14 oz. It is recommended, therefore, that a mixture of oleoarsenite and road dust (1 : 1) should be used at rates not exceeding 14 oz. per acre.

Injury somewhat similar to that due to dusting with Paris green or oleoarsenite was found to be caused by certain fungi and bacteria, so that care must be taken in the assessment of scorching by arsenicals.

[Latuishev (N. I.) & Kryukova (A. P.).] **Латышев (Н. И.) и Крюкова (А. П.). On the Epidemiology of the cutaneous Leishmaniasis. Cutaneous Leishmaniasis as a Disease of wild Rodents in Turkmenia. (In Search of a Solution of the Sandfly Problem. VI.)** [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **25** pp. 229–242, 2 pls., 8 figs., 9 refs. Leningrad, 1941. (With a Summary in English.)

Investigations on the animal reservoirs of cutaneous leishmaniasis (*Leishmania tropica*) in southern Turkmenistan were carried out in 1937 and 1938 in a section of the valley of the Murghab where sandflies were abundant and the entire population was affected by the disease. They confirmed Vlasov's findings [*R.A.E.*, B **23** 51] that the breeding of sandflies in the sandy desert occurs in the burrows of rodents, which have a suitable microclimate. Of sandflies taken in an endemic focus of leishmaniasis in the summer of 1937 and examined, 3·5 per cent., all of which were females of *Phlebotomus papatasii*, Scop., contained leptomonads in the gut ; none was found in the males or in examples of either sex of any of the other sandflies caught [*cf.* **32** 173]. In 1938, about 2,000 sandflies were trapped on their way out of the burrows of rodents, and up to 6 per cent. of the females of *P. papatasii* were found to harbour leptomonads. Since the burrows had been isolated in such a way that no sandflies could enter them from without and the examination was not begun until the traps had been installed for about a month, the trapped females must have developed in the burrows and become infected there, presumably from the rodents [*cf.* **32** 173].

Experiments in 1937 showed that the gerbilles, *Rhombomys opimus* and *Meriones erythrourus*, with which sandflies are closely associated, could easily be infected by inoculation of *Leishmania tropica* originating from man, positive results being obtained in almost all cases, with incubation periods of only 7–12 days. In the following year, 1,087 examples of *R. opimus*, 26 of *M. erythrourus* and 45 ground-squirrels (*Spermophilopsis leptodactylus*) were examined between the end of May and the begining of December for natural infection, and 241, 4 and 3, respectively, were found to harbour leishman bodies. In the case of *R. opimus*, the percentage infected increased from 2·3 in June to 56·3 in November-December. Infected gerbilles did not appear to be associated particularly with human settlements, since they were also found at distances of up to five miles from them, but they were numerous in the valley, in which *P. papatasii* predominated, and rare in the mountains, where the prevalent sandflies were *P. sergenti*, Parr., *P. caucasicus*, Marz., and *P. minutus*, Rond.

Gerbilles artificially infected at the beginning of October still harboured the parasites at the end of the following March. The identity with *L. tropica* of the leishman bodies in gerbilles was confirmed by the production in man of sores typical of the moist form of dermal leishmaniasis (pendinka) [*cf.* **32** 173] by injecting or by rubbing into the scarified skin matter from the ear of a naturally infected example of *R. opimus*. Other experiments showed that natural or artificial infection of *R. opimus* confers no immunity from a second infection, and it is concluded that gerbilles can contract the disease repeatedly throughout their life. Since new infections were found in them from the beginning of June to the end of November, whereas they occurred in man only from the end of July to October, it is thought that sandflies are active in the burrows over a longer period than in dwellings and outhouses.

It is concluded from these investigations that cutaneous leishmaniasis is essentially a disease of rodents in the desert, and that man is only affected by it if epidemiological conditions are favourable. This would explain the frequently observed occurrence of severe outbreaks in small isolated settlements or among troops or groups of workmen in completely uninhabited localities.

The best method of controlling the disease is thought to be fumigation of all the burrows in affected areas with chlorpicrin, which would destroy the rodent reservoirs and the sandfly vectors, and an experiment to test this was in progress at the time of writing [*cf.* **32** 173]. In a focus of the disease in which fumigation was impracticable, a considerable reduction in the numbers of sandflies was effected in 1938 by applying an adhesive on 14th July to the interior of a cave and six outhouses that served them as day-time shelters. A total area of about 2,700 sq. ft. was treated, and catches of sandflies on fly-papers from 15th July to 15th August showed a decrease of 88·7 per cent. as compared with the preceding six weeks and an increase of 13·5 per cent. in the controls.

[Petrishcheva (P. A.) & Izyumskaya (N. G.).] **Петрищева (П. А.) и Изюмская (Н. Г.). On Breeding Places of *Phlebotomus* in Sebastopol.** [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **25** pp. 243–254, 1 ref. Leningrad, 1941. (With a Summary in English.)

An account is given of investigations carried out in the summers of 1936 and 1937 in a part of Sebastopol in which sandflies (*Phlebotomus*) were very abundant in houses [*cf. R.A.E.*, B **33** 182]. To ascertain their breeding places, suspected sites were covered with wire gauze or (in the majority of cases) with wooden boxes containing sheets of fly-paper to catch the adults as they emerged. Adults were taken in boxes over cracks in the wooden floors of a living room and a clay sheep-pen, over droppings and rat holes in fowl-houses, and over wood shavings and rubbish in a clay hut used as a summer kitchen, and under netting at the base of dirty clay or brick walls with numerous cracks. Another method consisted in liberating large numbers of stained mature females during ten days in August in bedrooms that were kept semi-dark by day and in which the insects found favourable conditions for feeding and rest. It was assumed that they would not leave such shelter except to find suitable places for oviposition, and fly-papers were hung at 700 points thought to be likely breeding sites within a distance of 330 ft. from the houses. In all, 13,000 sandflies were released, and 258 gravid females were recovered, 33·7 per cent. of them under the floor, near cracks in the skirting or at the base of the walls in the houses in which they had been released and some in animal quarters and fowl-houses nearby. Of all the flies retaken, about 92 and 99 per cent. were within 40 and 80 ft. of the site of liberation. Gravid females were observed flying down the walls both inside and outside the houses, and such movements were a good indication of breeding places, immature stages subsequently being found in cracks or holes or under stones at the base of the walls where they were observed.

To find larvae and pupae, material from likely breeding places was washed by a process that is described. In all, about six tons comprising 965 samples were examined, and 28 samples (2·9 per cent.) yielded positive results, a total of 61 larvae and 91 pupae being found. Of the positive samples, 50 per cent. were taken from under the floors of inhabited houses and animal quarters, 32 per cent. from cracks and the burrows of rodents at the base of clay or stone walls, and 18 per cent. from under stones at the base of walls. The negative samples included material from dung heaps, débris from beneath trees, litter from animal quarters and rich soil from orchards and vegetable beds.

The control measures suggested are all directed to the destruction of potential breeding places. In Sebastopol, they should be carried out in May, before the adults first appear, and in July, before the peak of their abundance [*cf.* **33** 188].

[Perfil'ev (P. P.) & Podolyan (V. Ya.).] **Перфильев (П. П.). и Подолян (В. Я.). The Prophylaxis of *Phlebotomus* Fever by Means of Sandfly Control in City Conditions.** [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **25** pp. 255–271, 10 figs., 7 refs. Leningrad, 1941. (With a Summary in English.)

An account is given of a campaign in Sebastopol in 1939 similar to that organised in 1932–33 [*cf. R.A.E.*, B **33** 183] to control *Phlebotomus* and so reduce the incidence of sandfly fever. The measures employed consisted chiefly in the destruction of the adults by applying pyrethrum in a fly-spray or dust to walls, corners and other resting places in houses or burning it as a fumigant. Screening windows against sandflies and the removal of refuse, etc., in which breeding may occur were considered subsidiary measures that would not in themselves appreciably reduce the population, and experiments showed that treating potential breeding places with a 15–20 per cent. solution of chloride of lime [*cf. loc. cit.*] killed the larvae only in the upper layers of soil. Promising results were, however, obtained in small-scale experiments by the junior author with benzene polychlorides [a mixture of chlor- and dichlor-benzenes], which, when introduced into the soil at a depth of 4–10 ins. at the rate of 75 cc. per sq. metre [about 2¼ oz. per sq. yard], gave complete mortality in 24 hours of larvae that were placed in the soil at depths of 2–10 ins. immediately after treatment or 15 days later. The correct way of screening windows is described ; metal gauze is the best material, but muslin is also effective and was rendered still more so in experiments by steeping it in an emulsion of tar prepared with potassium hydroxide.

A pyrethrum fly-spray was the best means of destroying the sandflies in houses, provided that it was dispersed as a fine mist ; it was much less effective when applied as a solid jet or in large drops. It has no repellent action. Good results were also obtained by alternately spraying the rooms and fumigating them with pyrethrum at the rate of 1½–2 oz. of the powder per 1,000 cu. ft. Sandflies should be systematically destroyed every day throughout the season. The campaign resulted in a reduction of 40–45 per cent. in the number of cases of sandfly fever in the treated area in 1939, as compared with 1938, when no control of sandflies was attempted, whereas there was an increase in 1939 in districts in which there was no control in either year.

[Perfil'ev (P. P.).] **Перфильев (П. П.). Data on the Sandfly Fauna of the USSR.** [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **25** pp. 272–283, 11 figs., 14 refs. Leningrad, 1941. (With a Summary in English.)

Detailed descriptions are given of the adults of both sexes of *Phlebotomus sequens* and *P. smirnovi*, spp. n. *P. sequens* was taken in 1939 in caves and rarely in houses on the south coast of the Crimea and was recorded in a previous paper as an unidentified species of the *minutus* group [*R.A.E.*, B **33** 183]. It apparently fed on lizards, which were numerous in the caves, and did not attack man or animals in the laboratory. *P. smirnovi* belongs to the *major* group and was taken in tents, caves and burrows in a locality stated to be in western Kirghizia in the text and in Tadzhikistan in the Russian and English summaries.

P. pirumowi, Burakova & Mirzayan [**23** 3] is considered a synonym of *P. tobbi*, Adlr. & Thdr. *P. chinensis*, Newst., which occurs in Central Asia, the Crimea and the Caucasus, is recorded for the first time from a mountain district near the town of Ordzhonikidze (North Caucasus). Males and females identified as *P. clydei*, Sinton, taken in two localities in Central Asia, stated to be in Turkmenistan and Kazakhstan in the text and in Tadzhikistan and Uzbekistan in the summaries [*cf.* **31** 162], agreed with Sinton's original description of the species from northern India, except that the pigmented area in the buccal cavity of the females from Central Asia was less developed.

[Ekzemplyarskaya (E. V.).] **Экземплярская (Е. В.). On the Fate of the Tubercle Bacillus in the Body of** *Tenebrio molitor*. [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **25** pp. 284–294, 2 col. pls., 17 refs. Leningrad, 1941. (With a Summary in English.)

The author briefly discusses the possibility of the dissemination by insects of pathogenic bacteria that are not usually dependent on them for transmission and describes experiments which showed that tubercle bacilli ingested by larvae and adults or injected into larvae, pupae and adults of *Tenebrio molitor*, L., are rapidly phagocytised in the haemolymph but persist from stage to stage. Virulent bacilli were voided by larvae and adults given an infective meal and by adults that developed from such larvae.

Simmons (S. W.) & Dove (W. E.). **Experimental Use of Gas Condensate for the Prevention of Fly Breeding.**—*J. econ. Ent.* **38** no. 1 pp. 23–25, 3 refs. Menasha, Wis., 1945.

Gas condensate is a by-product resulting from the manufacture of coal gas, and some plants produce both a light and a heavy fraction. This paper deals with tests of the condensate for the control of the immature stages of stable flies [*Stomoxys calcitrans*, L.] and house-flies [*Musca domestica*, L.] in decaying vegetable matter. Mortality was practically complete in stable-fly larvae of all instars, when about 19 miles of heavily infested tidal drift [*cf. R.A.E.*, B **31** 95] in north-western Florida, with an average width of 44 ins. and a depth of 11 ins., were treated with a mixture of equal parts of the light fraction and fuel oil applied at the rate of 296 U.S. gals. per mile of vegetation under a pressure of 650 lb. This is considerably less than the dosage of creosote generally used [*cf. loc. cit.*]. Under favourable conditions, light gas condensate remained in the medium for about two weeks. A little breeding was once observed 16 days after treatment, but the addition of the heavy fraction might lengthen effectiveness by reducing volatility. In September 1941, heavily infested piles of the vegetation were well sprayed with the same mixture and caged. No flies emerged for 17 days after treatment (the duration of observations), while untreated controls produced hundreds. Representative results are given of numerous tests in which ground-nut litter [*cf.* **30** 61] was sprayed with light gas condensate. The average reduction in emergence of stable flies was over 99 per cent., adequate control was obtained with 0·11 U.S. gal. per cu. ft., and none of the treated litter became re-infested. There was no obvious adverse effect on the crops grown on the land in the following year. Several tests showed that the breeding of house-flies in manure could be effectively controlled with light gas condensate if penetration was adequate, but no details are given. An undiluted mixture of 60 per cent. light and 40 per cent. heavy gas condensate applied to celery strippings [*cf.* **31** 100] at a pressure of 250 lb. and a rate of 22 U.S. gals. per 78 cu. ft. and a 10 per cent. solution of the mixed condensate at the rate of 55 U.S. gals. per 72 cu. ft. killed all larvae of stable flies and house-flies except in imperfectly treated areas. Results were not satisfactory when only the surface was treated, but this was true of creosote also. In the test of the dilute spray, 19·1 per cent. emergence occurred from pupae collected three days after treatment. With violent agitation and ejection under high pressure, the condensate may be sprayed as a mixture with water. Complete kills of larvae of both species in celery waste were obtained with 20 per cent. condensate in water or 10 per cent. in fuel oil. The average dosage in tests on celery waste was 0·6 U.S. gal. per cu. ft., but complete kills were obtained in shallow piles with as little as 0·15 U.S. gal. Improperly treated celery strippings are more subject to re-infestation by house-flies than treated ground-nut litter or marine vegetation to re-infestation by stable flies. Celery litter was still well impregnated 24 days after treatment and contained no larvae or pupae of the stable fly and only a few house-fly larvae in lightly treated areas.

Overwintering Ecology of the Screwworm—A Symposium.—*J. econ. Ent.* **38** no. 1 pp. 66–95, 4 figs., 8 refs. Menasha, Wis., 1945.

The following are the titles of the papers in this symposium with abstracts of their contents based mainly on the authors' summaries.

Parman (D. C.). **Effect of Weather on *Cochliomyia americana* and a Review of Methods and economic Applications of the Study** (pp. 66–76, 3 refs.). Normal overwintering of *Cochliomyia hominivorax*, Coq. (*americana*, Cush. & Patt.) in the United States is confined by climate to the extreme south [*R.A.E.*, B **28** 238]. The adults have no well-defined resting stage, but development and activity are retarded during the cooler months. Tests in Florida, Georgia, Texas and Arizona indicated that the average daily mean temperature for periods of three and five months determined whether overwintering took place in these areas. The critical temperature was about 49°F. for three months and about 53°F. for five. Most adults and pupae are killed when minimum temperatures fall below 20 and 15°F., respectively. Pupae withstand cold better in dry media than in moist or wet ones. The longest pupal period was 78 days. With an average daily mean temperature of 47·6°F., the lowest at which pupae survived, the minimum period covered was 58 days and emergence continued for 77 days. The total emergence from this series in dry range soil was 19 per cent.

Other factors limiting the degree of overwintering included rainfall, available hosts and population of the fly at the beginning of winter. Adults live longest during cool, moist periods. The egg and larval stages usually are not materially affected by weather. The maximum period of carry-over of one generation was 121 days, and the possible carry-over of combined maximum periods of all stages was 164 days. There was no evidence that caves, animal burrows or accumulations of manure increased the area of overwintering. The study indicated that shearing sheep earlier and over a shorter period in the autumn would greatly reduce infestation in them.

Lindquist (A. W.) & Barrett jr. (W. L.). **Overwintering of *Cochliomyia americana* at Uvalde, Texas** (pp. 77–83, 2 refs.). Small numbers of *C. hominivorax* survived the winter of 1935–36, when the mean temperature was 52·2°F., mainly because there was a warm period in mid-winter when docking, marking and castration resulted in the availability of wounds in thousands of animals. In the winter of 1936–37, the mean temperature was 54·3°F. and the species again survived, apparently because of a period of activity in mid-winter. Survival occurred in the following winter when the mean temperature was 55·5°F., and to a slight extent in 1938–39 when it was 54°F. *C. hominivorax* did not show any tendency to hibernate; progressively declining temperatures from a mean of about 55°F. lengthened the developmental period and increased mortality of the immature stages. Apparently a mean average daily air temperature of about 51°F. was fatal to most of the immature stages in the soil. All adults were killed in cages at a minimum of 19°F., and fell to the ground at a minimum of 22°F., although they revived with a rapidly rising temperature and later oviposited. Oviposition occurred in the field at 61°F., after several days with much higher temperatures.

Parish (H. E.). **Overwintering of *Cochliomyia americana* and *C. macellaria* at Menard, Texas** (pp. 83–84). Records taken during the winters of 1935–36 to 1938–39, inclusive, on about 62,000 exposed larvae and pupae of *C. hominivorax* indicate that the temperature in the neighbourhood of Menard, Texas, will not allow of their survival through the winter. No adults were obtained from 12,391 larvae and pupae of *C. macellaria*, F., exposed during the winter of 1936–37.

Brody (A. L.) & Rogers (E. E.). **Winter Activity of *Cochliomyia americana* in the Southeastern States** (pp. 85–89, 4 figs., 3 refs.). Experiments to determine the nature and extent of winter activity of *C. hominivorax* at Valdosta, Georgia, and Gainesville, Florida, were carried out during the four winters

from 1935 to 1939. All experiments at Gainesville indicated that it could breed through the winter there, but Valdosta seemed to be nearer the northern limit of overwintering. Breeding experiments in outdoor cages were carried out during the four years, but *C. hominivorax* survived only through the winters of 1936–37 and 1938–39. A few natural cases of infestation were observed, however, during a warm period in January 1936. Soil has some significance in relation to survival. Well-rotted manure apparently provides some protection as survival and speed of development from larva to adult were higher in cold weather in this medium than in soil. There was no true hibernation period. Development of the immature stages in the soil under normal summer conditions takes 7–9 days, but under winter conditions at Valdosta it was prolonged in one case to 78 days, and at Gainesville may take 63 days. Adults were kept alive for 64 days.

Deonier (C. C.). **Overwintering and Dispersion of *Cochliomyia americana* in Arizona** (pp. 90–95). *C. hominivorax* did not survive the abnormally cold winter of 1936–37 in Arizona. A monthly mean of 41·6°F. was fatal to all mature larvae and pupae during January at Tempe. The ranges were apparently re-infested by adults from Mexico. Such re-infestations depend on favourable weather conditions in Arizona, and their lateness and drought conditions in 1937 prevented wide distribution and the building up of an appreciable population before the summer rainy season. The fly survived the winter of 1937–38 in the warm valleys of southern Arizona, and breeding continued through most of the winter. A mean soil temperature of 51·3°F. in grass sod at Tempe prevented development of immature stages in the soil. The pupae developed in leaf mould with a mean temperature of 52·1°F. The maximum period of development of immature stages in the soil was 70 days.

Schoof (H. F.), Schell (S. C.) & Ashton (D. F.). **Survival of Anopheline Larvae and Pupae in Muck.**—*J. econ. Ent.* **38** no. 1 pp. 113–114. Menasha, Wis., 1945.

Certain coastal areas in North Carolina are subject to wind tides which cause the rivers and creeks to flood adjacent land for periods of 1–20 days or sometimes for brief periods several times in a single week. The breeding places of *Anopheles quadrimaculatus*, Say, in these areas include many, such as muddy ditches, hoof prints, pig wallows and heavily shaded swamps, that would not usually be considered suitable for it. In 1934, adult Anophelines occurred in numbers that could not be explained from the apparent number of larvae, but the results of an intensive search indicated that the larvae and pupae in flooded areas could submerge themselves in mud when the water receded and resume development when the water level rose again.

To test this theory, Anopheline larvae and pupae were put into a bucket containing mud and water, the water was drawn off after a few minutes until only moderately thick mud was left, and the bucket was then placed in the open where it was exposed to direct sunlight for about two hours daily. When water was added after 29 hours, the mud being then of the consistency of putty, one out of three second-instar larvae, two out of three third-instar larvae, seven out of nine fourth-instar larvae and all of four pupae were alive. All surviving larvae and pupae rose to the surface. Three adults of *A. quadrimaculatus* emerged from three pupae within twelve hours, and two of the fourth-instar larvae pupated and produced adults of the same species. The other larvae and the remaining pupa died. In a similar test in which the exposure period was 48 hours, the mud was still uniformly moist, but thick and sticky, when the water was added. Two third-instar larvae were dead, but three out of 14 fourth-instar larvae and all of four pupae were alive. Three females of *A. quadrimaculatus* and one male of *A. punctipennis*, Say, emerged from the pupae. Two of the surviving larvae died and the third pupated and then died.

On 6th September, a ditch that carried waste water from a house was found to be apparently dry, the bottom being formed of slimy mud. Two days later, it contained a shallow layer of soapy water in which 44 third- and fourth-instar larvae of *A. quadrimaculatus* and numerous fourth-instar larvae and pupae of other mosquitos were found. They must have been in the ditch when it was first inspected. The distribution of the larvae of *A. quadrimaculatus* indicated that they were not in the only portion of the ditch disregarded on the first occasion, and that they must, therefore, have been in the mud.

Barnes (R. C.). *Anopheles walkeri* **in diurnal Shelters in Massachusetts.**—*J. econ. Ent.* **38** no. 1 p. 114, 4 refs. Menasha, Wis., 1945.

Adults of *Anopheles walkeri*, Theo., are rarely found in diurnal shelters of the type used for measuring densities of *A. quadrimaculatus*, Say. Records of their being taken in their daytime resting places are reviewed, and data are given on collections made in eastern Massachusetts in August and September 1943. The 1,096 adult Anophelines taken in 107 inspections made in three localities included 18 examples of *A. walkeri*, all of which were females and were found in animal shelters in fairly dry situations on the ceilings and upper walls [*cf. R.A.E.*, B **32** 33]. The largest number in one place was seven in a cow-shed. Inspections were also made in culverts, hollow trees and outbuildings and under houses and bridges, but the numerous Anophelines taken did not include *A. walkeri*, and it was not represented among 124 large Anopheline larvae taken in 24 collections in the same localities.

Eyles (D. E.) & Burgess (R. W.). *Anopheles walkeri* **in South Carolina.**—*J. econ. Ent.* **38** no. 1 p. 115, 3 refs. Menasha, Wis., 1945.

The first published record of *Anopheles walkeri*, Theo., in South Carolina was that of Bradley, Fritz & Perry [*R.A.E.*, B **32** 194], but there was evidence that it was breeding in the marshes at the mouth of the Savannah River at least as early as 1939. A search for larvae made there on 10th May 1944 was unsuccessful, but 16 females were taken in one hour on that date, about 18 more two days later, 180 in three hours on 26th May and over 600 in a shorter time on 14th July. Small numbers of *A. quadrimaculatus*, Say, and *A. crucians*, Wied., were caught on each occasion.

Pierpont (R. L.). **Terpin Diacetate as an Activator for Pyrethrum.**—*J. econ. Ent.* **38** no. 1 pp. 123–124, 1 graph. Menasha, Wis., 1945.

The results are given of experiments in which adults of *Musca domestica*, L., were sprayed by the Peet-Grady method with a petroleum distillate containing 25, 50 or 100 mg. pyrethrins per 100 cc., alone and with 2·5, 5 or 10 per cent. terpin diacetate. At each concentration of pyrethrins the toxicity of the spray was increased by the addition of the diacetate, and there was a marked, though smaller, increase with each increase in concentration of the latter. All the combinations showed the rapid action of pyrethrum.

Stabler (R. M.). **New Jersey Light-trap versus human Bait as a Mosquito Sampler.**—*Ent. News* **56** no. 4 pp. 93–99, 4 refs. Lancaster, Pa., 1945.

For 45 nights during July and August 1944, the author exposed himself to the bites of mosquitos for 30 minutes, beginning at dusk, and a New Jersey light-trap [*R.A.E.*, B **31** 195, etc.] with a 25-watt, white-frosted bulb was operated throughout the night, 82 ft. away. Of the 1,571 females taken, 70·3 per cent. were caught biting and 29·7 per cent. in the trap. They included 1,206 of *Culex* spp., 196 of *Aëdes vexans*, Mg., 62 of *A. cantator*, Coq., and 74 of *Anopheles punctipennis*, Say, of which 73·6, 52, 96·8 and 63·5 per cent.,

respectively, were taken biting. Thus, the proportions of the different species in the two catches were somewhat similar [*cf.* **32** 75–76], except in the case of *Aëdes cantator*. Other species were not attracted in sufficient numbers to warrant comparison. The effectiveness of the human bait may have been increased by the proximity of the light-trap, and the author knew from previous experience that his attractiveness to mosquitos was above the average [*cf.* **33** 2].

Munro (J. A.) & Knapp (R.). **Effect of DDT on Cattle Lice.**—*Bi-m. Bull. N. Dak. agric. Exp. Sta.* **7** no. 4 p. 21. Fargo, N. Dak., 1945.

In preliminary tests in North Dakota, three steers appeared to have been freed in 24 hours from a heavy infestation of *Damalinia* (*Bovicola*) *bovis*, L., by one application of 10 per cent. DDT in pyrophyllite, and a moderate infestation of *Haematopinus eurysternus*, Nitzsch, on three heifers was reduced by more than 90 per cent. Small numbers of recently hatched lice of both species were observed on the treated animals three weeks after dusting, but subsequent weekly examinations revealed no lice. The mixture tended to clog the opening of the shaker-top container used to apply it.

DDT for the Control of Roaches.—*Bull. U.S. Army med. Dep.* no. 89 pp. 16–17. Washington, D.C., 1945.

Data are given on the application and effect against cockroaches of preparations containing DDT supplied to the U.S. army. A dust of 10 per cent. DDT in talc is applied lightly with a hand-operated dust gun in mess halls and kitchens, particularly in crevices and under furniture. Food, utensils and table tops are covered during dusting. A spray of 5 per cent. DDT in refined kerosene is applied, preferably after the evening meal, to the same places with hand or power sprayers, fires having previously been banked or extinguished and precautions taken to prevent contamination of food and mess equipment. The residue from the spray is less unsightly than the dust and less readily removed by cleaning. A thorough application will give protection for several weeks, the duration of effectiveness varying to some extent with the frequency with which the coated surface is washed. The dust method is, however, the more effective against *Blattella germanica*, L., and the rate of application of spray per unit area required to control it may be higher than that required against *Periplaneta americana*, L., which is less resistant to DDT in any form. A spray of 1 per cent. DDT and 2·5 per cent. Thanite [fenchyl thiocyanoacetate] in refined kerosene is atomised as a direct contact insecticide against mosquitos and other insects. The only precautions necessary are those to prevent gross contamination of food. It is possible that its repeated use might build up a sufficient deposit of DDT on surfaces to have some effect on cockroaches, but its application for this purpose alone would be wasteful.

Vargas (L.) & Colorado Iris (R.). **Acción del DDT sobre algunos artrópodos domésticos.** [Action of DDT on some House-frequenting Arthropods.]—*Rev. Soc. mex. Hist. nat.* **5** no. 3–4, pp. 229–235, 20 refs. Mexico, D. F., 1944. (With a Summary in English.)

Brief notes are given on the distribution and habits of *Centruroides limpidus*, Karsch, *Ornithodoros nicollei*, Mooser, *O. turicata*, Dugès, and *Latrodectus mactans*, F., followed by an account of experiments made in Mexico on the toxicity of DDT to them and to *Blattella germanica*, L. The Arthropods were kept continuously in small dishes on a layer of a commercial preparation of DDT or a dust of 10 per cent. DDT in a diluent or on filter paper impregnated by soaking it in a 20 per cent. solution of DDT and allowing the solvent to evaporate, and except in the case of *Latrodectus* and *Blattella*, the observations

were continued for a fortnight. Ticks on the commercial DDT or the 10 per cent. dust lay on their backs after the first day and those that survived for eight days were unable to bite a guineapig. Three of ten individuals of *O. nicollei* on the commercial DDT, and one out of ten on the 10 per cent. dust, died on the sixth day. Out of 20 on the filter paper, five died on the seventh and five on the ninth days. Two of ten individuals of *O. turicata* on the 10 per cent. dust died on the sixth day, and 15 out of 20 on the filter paper died between the sixth and ninth days. *B. germanica* and *L. mactans* were not affected by contact with the filter paper during the six days for which the experiment was continued, but a single example of *Cimex lectularius*, L., used as a control, died on the first day. Young examples of *Centruroides* just after the first moult were killed in 24 hours on the 10 per cent. dust or filter paper, and the adult scorpions died in 72 hours or less on the commercial DDT or the 10 per cent. dust and few survived more than 12 days on the filter paper.

[Sokolov (N. P.).] **Соколов (Н. П.). An experimental Hygrochamber for the Study of the Reactions of Insects to Humidity.** [*In Russian.*]—*Izv. uzbek. Fil. Akad. Nauk SSSR* 1940 no. 2–3 pp. 82–86, 2 figs. Tashkent, 1940.

The author describes and illustrates an apparatus in which insects can be exposed to a gradient of atmospheric humidity. It consists of an air-tight box of metal and glass 92 cm. long, 4·2 cm. high and 10 cm. wide, in the floor of which are seven cavities that contain petri dishes and hygrometers, arranged alternately and at equal intervals. The dish at one end contains distilled water and the other three the requisite amounts of sulphuric acid or calcium chloride, and a gradient of 10–95 per cent. relative humidity is thus obtained. The insects are introduced through one end. The hair-hygrometers employed were specially designed by N. V. Il'inskiĭ for use in the apparatus and are also described and illustrated.

To test the accuracy of the chamber, females of *Anopheles maculipennis*, Mg., that had fed some time before were liberated in it, and the results of observations on their distribution are shown in tables. After first dispersing evenly through the chamber, they gradually concentrated in the zones of higher humidity and then remained for hours without changing their position. Statistical treatment of the data showed that there was a direct relation between the humidity and the distribution of the mosquitos.

[Brodskiĭ (A. L.).] **Бродский (А. Л.). Zoological Section of the Uzbek Branch of the Academy of Science in 1940.** [*In Russian.*]—*Izv. uzbek. Fil. Akad. Nauk SSSR* 1941 no. 1 pp. 65–72. Tashkent, 1941.

This report includes a summary (pp. 70–71) of work in 1939 and 1940 on the sheep bot-fly [*Oestrus ovis*, L.] which is widely distributed and harmful in pasture lands in the semi-desert areas of Uzbekistan. It was found that the adults emerge from 1st May to 15th June and again from 1st September to 10th November, that they are not present in very large numbers and that they become inactive and congregate at particular places under certain conditions, though these are not specified. In view of these findings, hand collection was tried as a measure of control. In preliminary experiments in a village in the region of Bokhara in 1939, it resulted in a decrease in the infestation of sheep by over 60 per cent. In 1940, no flies were found in autumn in a village in which they had been collected in the spring, in spite of the presence of over 2,000 sheep, whereas 1,394 were collected in five control villages between 9th September and 6th November.

It is concluded that hand collection in spring and autumn is an effective measure of control, and that its value is increased if the sheep are moved to fresh pasture before the emergence of the flies.

THOMAS (I.) & WILLIAMS (G.). **The Control of Warble Flies with Nicotine Sulphate.**—*Welsh J. Agric.* **18** pp. 79–80, 2 refs. Cardiff, 1945.

A dressing composed of 2 fl. oz. nicotine sulphate, 1 lb. hydrated lime and 1 gal. water was for a time recommended by the Ministry of Agriculture for the control of larvae of warble-flies [*Hypoderma*] in cattle in England and Wales, but the recommendation was withdrawn as cases of severe poisoning of the cattle were recorded; some of the treated animals became unconscious and frothed at the mouth and a few had to be slaughtered. In experiments by the authors, this dressing was tested on about 200 cattle on five farms in Wales. On four of the farms, a first application was made in late March and a second 32–34 days later. The scabs were removed with a hard brush dipped in the dressing and it was then applied with fine sacking at the rate of 1 gal. for 30 cattle. The animals were slightly affected by it, and a few were lying down a short time afterwards, but they did not seem distressed. When the second application was made, the first was seen to have been very effective, many dead larvae being found half way out of the holes. Some of the animals became extremely agitated when treated for the second time, especially if a little of the dressing entered the cavities left by the dead larvae; a few shivered violently, but the reaction was not nearly so severe as that described by other workers. At the fifth farm, the animals were only slightly agitated by one application of the dressing, but the man who applied it suffered from headaches and vomiting and was confined to bed for a few days. He had been affected by a nicotine dust some years previously. It is concluded that a nicotine-sulphate dressing may poison both animals and workers unless precautions are taken. It should be applied in the open air or in an open shed and to the warbles only, and a mop should be used to prevent hardening and scaling of the skin of the hands.

SAUTET (J.) & D'ORTOLI (M. F.). **Variations biologiques et morphologiques de l'***Anopheles maculipennis*.—*C. R. Soc. Biol.* **138** no. 17–18 pp. 680–682. Paris, 1945.

Observations are recorded in which it was found that there was no correlation between the duration of the larval stage and that of the pupal stage among individuals of *Anopheles maculipennis*, Mg., reared under uniform conditions from females taken in nature in animal quarters. A pupal stage of four days followed larval stages of 18 or 33 days, while pupal stages of two and seven days both occurred after larval stages of 22 or 27 days. The duration of development was not related to the month (July, August or September) or to sex. It is also stated that the 26 eggs in a batch laid on 14th February 1944 by a female of *A. maculipennis* taken in an animal shed in the south of France and having a maxillary index of 15 showed great variations in the number of ribs on the floats and in the relation between the floats and the length of the egg, and that it would be possible from them to identify the female either as var. *atroparvus*, van Thiel, or var. *cambournaci*, Roub. & Treill. [which are, however, considered synonymous by some workers (*cf. R.A.E.*, B **28** 119; **29** 41; **31** 78)].

CHANDLER (A. C.). **Factors influencing the uneven Distribution of *Aëdes aegypti* in Texas Cities.**—*Amer. J. trop. Med.* **25** no. 2 pp. 145–149, 1 ref. Baltimore, Md., 1945.

A survey made in 1942 and other evidence showed that the prevalence of *Aëdes aegypti*, L., in towns in Texas is very variable in early summer. In the Lower Rio Grande Valley, the winter is mild enough to allow the eggs and larvae to survive in considerable numbers without special protection, but elsewhere, extensive breeding in the early season is associated with an abundance of breeding places protected from extremes of weather, such as shallow wells,

cisterns and barrels of water for fire-fighting in warehouses. A high breeding index does not occur until late summer in towns having few such places, and the mosquito may not occur at all in many of the smaller towns unless it is introduced by car or other transport, in which case it does not become abundant unless it is introduced early in the season. In coastal towns, alternation of cold and warm periods during the winter is of importance, as eggs hatch during the warm spells and the young larvae cannot withstand the subsequent cold. It may do more to keep the mosquito in check than the extremes of cold or the total amount of cold weather. Eggs and larvae can survive short exposure to temperatures below freezing point, but larvae exposed to temperatures of about 40°F. or less for several days almost invariably die, apparently from drowning, as they become unable to rise to the water surface. According to observations made by C. J. Rohde, larval activity does not cease until the temperature falls below 40°F.

Huffaker (C. B.) & Back (R. C.). **A Study of the effective Flight Range, Density, and seasonal Fluctuations in the Abundance of** *Anopheles quadrimaculatus* **Say in Delaware.**—*Amer. J. trop. Med.* **25** no. 2 pp. 155–161, 5 figs., 14 refs. Baltimore, Md., 1945.

An account is given of observations made in Delaware in 1942 confirming the conclusions of other workers that *Anopheles quadrimaculatus*, Say, does not normally occur in significant numbers more than one mile from its breeding places [*cf. R.A.E.*, B **30** 74, etc.]. The sites searched were cattle sheds and kegs [**31** 52] near them. The records from the two sources were closely correlated. However, production at the two large breeding areas involved was very heavy, and 250 females per shed per inspection were found one mile from the breeding areas, though this was only 5 per cent. as many as the average 0·1 mile from them. It was a large enough number to be dangerous from the point of view of malaria transmission. Near the sources of production, as many as 15,000–25,000 females per shed per inspection were commonly found, and in 1941, it was once estimated that there were 40,000 in one shed. Observations in 1941 and 1942 indicated that broods of *A. quadrimaculatus* are produced approximately monthly during the summer season in the locality. In 1942, the senior author reported the presence of some 10,000 females of *A. quadrimaculatus* overwintering in a cellar in Delaware in December 1941, of which only 2–4 per cent. survived until the following spring. Large numbers were found in the same cellar in January 1943 [*cf.* **24** 221].

Smithburn (K. C.) & Haddow (A. J.). **Semliki Forest Virus. I. Isolation and pathogenic Properties.**—*J. Immunol.* **49** no. 3 pp. 141–157, 6 refs. Baltimore, Md., 1944.

Smithburn (K. C.), Mahaffy (A. F.) & Haddow (A. J.). **II. Immunological Studies with specific antiviral Sera and Sera from Humans and wild Animals.**—*T.c.* pp. 159–173, 8 refs.

The first paper deals with the properties of a neurotropic virus isolated from mosquitos belonging to the group of *Aëdes abnormalis*, Theo., caught in August 1942 in a forest in Bundinyama, Bwamba, a thickly populated district with numerous deep ravines containing remnants of primeval forest, continuing the main Semliki Forest, in western Uganda. The infected females probably belonged to the only species of the *abnormalis* group that had been found in Bwamba; it differs from every known member of the group in coloration and male terminalia and appears to be almost confined to forest and dense bush, where it bites man freely by day and just after sunset. The virus was lethal to mice by various routes of inoculation and to guineapigs, rabbits, rhesus monkeys [*Macaca mulatta*] and red-tail monkeys (*Cercopithecus nictitans*)

by intracerebral inoculation. When introduced extraneurally into resistant hosts and some susceptible ones, it induced the formation of protective antibody without causing marked illness.

Cross neutralisation tests, described in the second paper, showed it to be distinct from the viruses of eastern and western equine encephalomyelitis, St. Louis encephalitis, Japanese B encephalitis, yellow fever and Bwamba fever and the West Nile virus. Persons living in each of four widely separated areas of Uganda, including children in three of them, were found to possess protective antibody against it. Sera from 20 species of wild animals, including 12 primates, were examined, and protective antibody was found in six primates, including 11 out of 17 examples of *C. nictitans*.

It is known that the virus can survive at least 48 hours in mosquitos, as the infected females reached the laboratory two days after the last of them were caught. Transmission experiments indicated that *A. aegypti*, L., and *Mansonia* (*T*[*aeniorhynchus*]) *fuscopennata*, Theo., are not vectors, though the virus may survive in either for several days. It did not appear from experiments with mice that the disease is normally acquired by contact, though transmission occurred in one instance.

PAPERS NOTICED BY TITLE ONLY.

[PAVLOVSKIĬ (E. N.) & ALFEEVA (S. P.).] **Павловский (Е. Н.) и Алфеева (С. П.). Histopathological Modifications in the Skin of Cattle from the Bite of the Tick** *Ixodes ricinus*. [*In Russian.*]—*Trav. Acad. milit. Méd. Kiroff Armée Rouge* **25** pp. 153–160, 8 plates (2 col.), 8 refs. Leningrad, 1941. (With a Summary in English.)

[RUBTZOV (I. A.).] **Рубцов (И. А.). Notes on the Black-flies (Simuliidae) of Transbaikalia** [including two new species]. [*In Russian.*]—*Mag. Parasit.* **7** 1939 pp. 193–201, 2 figs., 3 refs. [? Leningrad, 1940.] (With a Summary in English.)

[RUBTZOV (I. A.).] **Рубцов (И. А.). Simuliidae of the Lake Sevan and the Ciscaucasus** [including two new species]. [*In Russian.*]—*Trudui sevansk. gidrobiol. Stantz.* **6** pp. 79–85, 4 figs., 2 refs. [*Sine loco*, n.d.] (With a Summary in German.)

DAMPF (A.). **Notas sobre flebotómidos mexicanos. I. Observaciones generales y descripción de dos especies nuevas** (*Phlebotomus oppidanus* **y** *Phl. vindicator*) **encontradas en la ciudad de México (Ins. Diptera, Fam. Phlebotomidae).**—*Rev. Soc. mex. Hist. nat.* **5** no. 3–4 pp. 237–254, 4 pls., 56 refs. Mexico, D. F., 1944. (With a Summary in English.)

THURMAN (D. C.), OGDEN (L. J.) & EYLES (D. E.). **A United States Record for** *Culex interrogator*.—*J. econ. Ent.* **38** no. 1 p. 115, 1 ref. Menasha, Wis., 1945.

MACCREARY (D.). **Some Ectoparasites, excluding Ixodoidea, of Delaware Mammals** [chiefly mites and fleas from rodents].—*J. econ. Ent.* **38** no. 1 pp. 126–127. Menasha, Wis., 1945.

TOVAR (R. M.). **Rickettsioses exantemáticas transmitidas por garrapata en América (Tick-borne Typhus Fever).** [The Rickettsial Spotted Fevers transmitted by Ticks in America (review of the literature).]—*Medicina* **25** nos. 479, 480 pp. 65–85, 89–96, 9 figs., 71 refs. Mexico, D. F., 1945. (With Conclusions in English.)

LÄUGER (P.), MARTIN (H.) & MÜLLER (P.). **The Constitution and Toxic Effect of Botanicals and new synthetic Insecticides** [with special reference to DDT].—43 pp., 12 figs., 6 refs. New York, N.Y., Geigy Co., Inc., 1945. [Translation : See *R.A.E.*, B **34** 20.]

FAROOQ (M.) & QUTUBUDDIN (M.). **Oriental Sore in the Nizam's Dominions. Some epidemiological Factors.**—*Indian med. Gaz.* **80** no. 2 pp. 85–89, 1 map, 12 refs. Calcutta, 1945.

Oriental sore [caused by *Leishmania tropica*] is thought to have been long established in the Nizam's Dominions, and reports of its presence at Jalna and Pattan, two towns 72 miles apart, were published in 1937 and 1943. An account is given of a survey of the occurrence of the disease and of species of *Phlebotomus* in these towns and at Aurangabad, all in Aurangabad district in the north-western part of the Dominions. Descriptions are given of the methods used and of the geographical situations and sanitary conditions of the towns. There were 4·8 cases of oriental sore per thousand persons examined at Aurangabad, 27·76 at Jalna and 42·6 at Pattan. The disease was much commoner in children than in adults, indicating the prevalence of immunity due to infection early in life.

The 940 adults of *Phlebotomus* caught in the three towns comprised 488 of *P. papatasii*, Scop., 317 of *P. argentipes*, Ann. & Brun., smaller numbers of *P. antennatus*, Newst., *P. babu*, Annan., and *P. bailyi*, Sinton, and one male of *P. sergenti*, Parr. The sexes were about equally represented. Out of 200 females of *P. papatasii* dissected, one from Jalna and one from Pattan were found to have flagellates in the midgut. No infection was found in other species. A search for the breeding places of the sandflies yielded only two unidentifiable larvae from a mixture of litter and soil from a cow-shed in an area where the only adults found were *P. papatasii*. The recommended control measures include keeping cow-sheds away from living quarters and, where this is not possible, removing all litter to manure pits away from houses and burning it, using a fly-spray twice weekly to kill the adult sandflies in infected localities, and destroying stray dogs that have sores.

NOOR HUSSAIN. **Typhus in Kashmir.**—*Indian med. Gaz.* **80** no. 3 pp. 132–133. Calcutta, 1945.

An epidemic of typhus occurred in the winter of 1942–43 in Kashmir, where the people live in congested huts in small villages and are infested with lice [*Pediculus humanus*, L.]. The seasonal incidence and epidemiology of the disease, its occurrence mainly in louse-infested people, the mortality (25–50 per cent.), clinical evidence and tests in which 67 out of 146 specimens of blood of suspected cases showed agglutination with Proteus OX19, six with OXK and none with OX2 indicated that nearly all the cases were epidemic louse-borne typhus.

SAPRE (S. N.). **The Systematic Position of *Ornithodorus crossi* Brumpt (1921).**—*Indian J. vet. Sci.* **14** pt. 1 pp. 54–55, 2 pls., 3 refs. Delhi, 1944.

The author gives descriptions of the adults of both sexes of a species of *Ornithodoros* that is common in the Punjab. Ticks from this area were described by Brumpt in 1921 as *O. crossi*, sp. n. [*cf. R.A.E.*, B **10** 63], but were later regarded by Pavlovsky [*cf.* **18** 216], by Nuttall & Warburton and by Brumpt himself as identical with *O. tholozani*, Lab. & Mégn. (*papillipes*, Bir.) from Russia. The author considers that his specimens are distinct from the latter and assumes that they are identical with the forms described by Brumpt, so that the name *O. crossi* should be reinstated for them. He gives a comparative table showing the characters of these ticks and also those given by various authors for *O. tholozani* and by Pavlovsky for *O. cholodkovskyi*, Pavl.

PEMBERTON (C. E.). **Entomology.**—*Rep. Comm. Exp. Sta. Hawaii. Sug. Pl. Ass. 1943–44* pp. 17–21. Honolulu, 1945.

Ampulex compressa, F., which was introduced into Hawaii in 1940 for the control of cockroaches [*R.A.E.*, B **31** 81, 107], is extending its range on

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Oahu and is established on Kauai. As only a few individuals were liberated on these islands, it is probable that liberations on other islands have also been successful. Between 1st October 1943 and 30th September 1944, 5,125 insects were taken from Army and Navy aircraft arriving at Oahu from regions outside Hawaii. Only 173 were alive. Five represented species that do not occur in Hawaii, but none of these would be harmful if established there. The dead insects that belonged to species not known in Hawaii included two examples of *Anopheles punctulatus*, Dön., 40 mosquitos of other genera and three examples of *Sessinia livida*, F., an Oedemerid beetle that causes an acute irritation of the skin upon contact.

DAVID (W. A. L.). **Factors influencing the Interaction of insecticidal Mists and flying Insects. Part I. The Design of a Spray Testing Chamber and some of its Properties.**—*Bull. ent. Res.* **36** pt. 4 pp. 373–393, 4 figs., 12 refs. London, 1946.

The following is taken from the author's summary. The considerations affecting the design of a spray testing chamber are discussed, and a description is given of equipment intended for use with mosquitos as the test insect. A metal chamber is surrounded by a " Masonite " cabinet with a space between, in which air at a constant temperature is circulated. The apparatus is fitted with lights, wet and dry bulb thermometers to check the humidity (which is controlled by blowing in steam), a fan to circulate the air, a spray gun, four ports closed by glass slides, through which the insect exposure cages are introduced into the chamber and which also serve as windows for observation of knockdown, a shelf to carry the cages, an intake and an exhaust port to allow of the removal of the mist at the conclusion of the test, and a door. The mosquitos are kept in cages when in the spray chamber, and they are introduced into it four minutes after spraying. They are exposed for ten minutes and then transferred to clean recovery cages.

The apparatus gives satisfactory results in practice, but the non-volatile contents of the sprays under comparison must be similar. When they are not, the spray that produces the less volatile mist gives the higher kill. In tests of activators for pyrethrum, which are usually non-volatile, it is therefore necessary to add an equivalent quantity of a non-volatile ingredient to the control spray. Specimen results are given to illustrate these points.

The results of tests of modifications of the routine procedure are given. It is concluded that temperature considerably influences kill, which decreased when temperature was lowered 10°C. [18°F.]. Relative humidity seemed to have little or no effect within the range of 40–80 per cent. Increasing the interval between spraying and the introduction of the insects from 0 to 10 minutes affected kill but not the comparative effectiveness of the insecticides. On the other hand, caging the insects had a pronounced influence on the comparative effectiveness of pyrethrin sprays with and without added non-volatile material, probably because the delay in access of the spray droplets to caged insects allowed differences in particle size to become established. With caged insects inserted before spraying, therefore, the biological effectiveness of a pyrethrin spray without added non-volatile material is much lower than when some such substance as high vacuum pump oil is added, whereas this difference is much smaller when the insects are exposed free in the cabinet.

RIBBANDS (C. R.). **Moonlight and House-haunting Habits of Female Anophelines in West Africa.**—*Bull. ent. Res.* **36** pt. 4 pp. 395–417, 3 figs., 13 refs. London, 1946.

Regular spraying to kill Anophelines in native dwellings as an anti-malaria measure [*cf. R.A.E.*, B **33** 201] was adopted in West Freetown and district, Sierra Leone, in 1940, and investigations on the habits in relation to houses

of the Anophelines concerned were carried out at Aberdeen, Sierra Leone, in 1941 and at Krabonekrom, in the Gold Coast, in 1942. The experimental areas are described. *Anopheles melas*, Theo., was the predominant Anopheline at Aberdeen [*cf.* **33** 34], but *A. gambiae*, Giles, bred in a freshwater seepage area. *A. funestus*, Giles, and *A. gambiae* were present at Krabonekrom, and *A. melas* in such small numbers that it could be ignored. Mosquitos were collected by covering the floor with sheets, spraying the room with pyrethrum extract in kerosene and collecting the mosquitos from the sheets five minutes later. Very few females entered empty huts for shelter only. Of those of the three species that entered occupied huts to feed, 97 per cent. remained until after dawn. *A. melas* showed no tendency to leave huts during the day when there was little light or ventilation, but about 25 per cent. left before 2 p.m. when the door was left open. There was a high correlation between the time at which females of *A. funestus* entered huts and the time of moonlight; the percentage that entered before 8 p.m. (100 minutes after sunset) was inversely related to the subsequent duration of moonlight, and it is concluded that this was due to the effect of moonlight in increasing the numbers that entered later. Flight was partly inhibited when there was no moon, and when the moon came out, the waiting mosquitos entered the huts in greatest numbers. The average proportions that entered during periods ending at 10 p.m., midnight and 7 a.m. was about 50 per cent., 100 per cent. and 400 per cent. greater, respectively, when the moon rose during these periods than on moonless nights. Many females waited until twilight on the evening following moonless nights before entering the huts, and consequently the average proportion that had entered by 8 p.m. was six times as great in moonless periods as on the nights after full moon. There was a similar but probably less close relation to moonlight in the case of *A. melas*, and it is likely that one exists in the case of *A. gambiae* also.

No direct correlation was found between the duration of moonlight and the total number of Anophelines that entered huts on any night. Morning twilight is less favourable for feeding than evening twilight, probably because the instinct to find shelter dominates the feeding instinct. The average rate of entry of females of *A. funestus* throughout one complete lunar cycle at Krabonekrom was 27 per cent. before 8 p.m., 22 per cent. between 8 p.m. and 10 p.m., 21 per cent. between 10 p.m. and midnight, and 30 per cent. after midnight. The corresponding percentages for *A. gambiae* (based on very few records) were 10, 20, 30 and 40. Comparable rates for *A. melas* are not available, but at least 45 per cent. entered before 10 p.m. in Sierra Leone, which is the equivalent of 11 p.m. Gold Coast time.

Demonstration of the close relationship between duration of moonlight and time of entry renders valueless observations on time of flight made over a short period without reference to moonlight, but Haddow's work [**30** 182] consists of weekly observations for a year so that the effects of moonlight are cancelled. Whereas 70 per cent. of *A. funestus* and 60 per cent. of *A. gambiae* entered huts within 5½ hours of sunset at Krabonekrom, only 45 and 40 per cent., respectively, entered within this period in Kenya. Climatic factors that may have accounted for the difference are discussed. The essential difference between the behaviour of females of *A. funestus* and those of *A. gambiae* is that the former fly earlier than the latter. *A. funestus* also seems to be more active at dawn, so that it is the more crepuscular in habit. There was no evidence that partly fed or gravid females entered the huts. Apparently, females usually become fully engorged at one feed. Unfed females formed 58 per cent. of the catches made at 8 p.m., showing that early entrants usually rest before they feed. Of the females taken after dawn, 95 per cent. were fully fed.

The fact that the females of the three species studied, which are the principal vectors of malaria in tropical Africa, nearly always remained until after dawn in the huts in which they had fed, and generally throughout the following day

also, justifies the policy of regular daytime spraying of all native dwellings with a pyrethrum preparation, though this method is now likely to be superseded by the use of DDT as a residual insecticide. Anophelines in European dwellings can only be usefully killed before they have fed. The large proportion of unfed females in the 8 p.m. catches indicates that spraying between one and two hours after sunset should be useful. Large freshly-applied doses of DDT on walls protect the occupants by incapacitating the mosquitos during the preliminary resting period. The results presented emphasise the importance of taking adequate personal precautions during the whole of the period from dusk to dawn. The maximum risk of transmission occurs during the hours of moonlight and at twilight on moonless nights.

BARNES (S.). **The Influence of certain biological Factors on the Resistance of Bed-bugs** (*Cimex lectularius*, **L.**) **to DDT.**—*Bull. ent. Res.* **36** pt. 4 pp. 419–422, 1 ref. London, 1946.

The results are given of experiments to determine whether the resistance of *Cimex lectularius*, L., to DDT varies with stage, sex, period of starvation or temperature. The bugs were either sprayed with various concentrations of DDT in a refined oil to give different deposits of active ingredient per sq. cm. and kept on the filter paper on which they were sprayed for 24 hours, or were exposed for two hours on dry filter papers that had been impregnated with a solution of DDT in a volatile solvent. All bugs were transferred to clean recovery tubes at the end of the exposure period, and mortality counts were made after six days. Resistance to both solvent and solute increased among nymphs in successive instars, and was greatest in adults. It did not differ with sex among recently fed young adults. After starvation for 10 or 20 days, young males were more resistant to DDT than females, whether gravid or virgin, starved for the same period. Virgin females were more resistant than gravid ones during the first seven days of starvation. The resistance of adults was lower 24 hours after feeding than for a few days afterwards, and was highest in males after starvation for five days and in gravid or virgin females after starvation for three. Adults kept at 30°C. [86°F.] before and after spraying were less resistant than those kept at 23 or 25°C. [73·4 or 77°F.]. There was 60 per cent. hatch among eggs that had been sprayed with 2 cc. of a 5 per cent. solution of DDT in the refined oil to give a deposit of 0·036 mg. DDT per sq. cm. and only 41 per cent. hatch among controls sprayed with the same amount of the oil alone, but the percentages of nymphs surviving from the two batches were 2 and 20, respectively.

GILLETT (J. D.). **Notes on the Subgenus** *Coquillettidia* **Dyar (Diptera, Culicidae).**—*Bull. ent. Res.* **36** pt. 4 pp. 425–438, 6 figs., 7 refs. London, 1946.

The following is based on the author's summary. Notes are given on some of the habits of mosquitos of the subgenus *Coquillettidia* of the genus *Mansonia* (*Taeniorhynchus*), with an account of the methods used for collecting and rearing the larvae in Uganda. Fourth-instar larvae of eight species were taken and reared to the adult stage, four of them for the first time. They included *M.* (*T.*) *atroapicalis*, sp. n., the adults of both sexes of which are described. Descriptions of the larvae and pupae of all eight species and keys to them are also given, and errors in previous descriptions of the larvae of two of the species are pointed out.

GARNHAM (P. C. C.), HARPER (J. O.) & HIGHTON (R. B.). **The Mosquitos of the Kaimosi Forest, Kenya Colony, with special Reference to Yellow Fever.**—*Bull. ent. Res.* **36** pt. 4 pp. 473–496, 2 pls., 3 figs., 21 refs. London, 1946.

The first recognised case of yellow fever in Kenya occurred near Kitale in 1942, and there was a second in 1943, the infection in this instance being

acquired in the Langata Forest near Nairobi. This was later shown to be a mild focus of the disease. The mosquitos taken in forested areas near Kitale in 1942 were *Anopheles implexus*, Theo., *Eretmapodites* sp. and eight species of *Aëdes*. This paper deals with a survey made between November 1942 and October 1944, on account of the occurrence of yellow fever in these areas and in neighbouring countries [*R.A.E.*, B **31** 61 ; **32** 110], to determine whether conditions suitable for the development of the disease exist in the Kaimosi rain-forest, which lies at an altitude of 5,500 ft. about 60 miles to the south of Kitale and on the traffic route from Uganda. The general environmental conditions are described.

The following is substantially the authors' summary. Particular attention was paid to the question of acrodendrophily or the preference shown by certain species of mosquitos for life in the tree-tops [*cf.* **32** 184]. A list is given of the 55 species of mosquitos found, showing the number of larvae and adults of each examined and indicating adult habits and breeding places in most cases. *Culex nebulosus*, Theo., *Aëdes capensis*, Edw., *A. fraseri*, Edw., *A. deboeri* subsp. *demeilloni*, Edw., and *A. longipalpis*, Grünb., breed in high tree-holes, the last almost entirely so. The many characteristically low breeders include *A. aegypti*, L., and *A. africanus*, Theo. There is an interesting distinction between the two commoner species of *Megarhinus* : *M. brevipalpis*, Theo., breeds high, *M. barbipes*, Edw., low. *A. apicoargenteus*, Theo., *A. fraseri*, *A. africanus* and *A. longipalpis* were found biting in the tree-tops ; the last two being rare in ground catches. Forest with a broken canopy proved best for adult catching, and the morning was a better time than the afternoon, which was usually overcast. Night searches gave negative results. Catches on high tree platforms appeared to be more prolific than those on the ground.

A. aegypti breeds commonly in recently felled trees at the forest edge and in rock pools in rivers in drought periods. Larvae are found a mile or more inside the forest. Breeding of this species has been discovered in neighbouring forest of the dry mountain type at an altitude as high as 6,500 ft. A series of observations showed that a larva of *Megarhinus* will often consume about 20 fourth-instar larvae of *A. aegypti* in a single night. The pupal stage of *Megarhinus* lasts on an average for nine days. *A. apicoargenteus* was the commonest mosquito in the adult stage and *A. capensis* in the larval stage. One female of the former survived 55 days in captivity. *A. africanus*, a known laboratory vector of yellow fever, shows a seasonal incidence, being commonest at the end of the long rains (August-November). Its favoured breeding places are pools in the buttresses of the tree, *Craibia elliottii*. The characteristic breeding place of *Culiseta* (*Theobaldia*) *fraseri*, Edw., contained 79 parts of oxidisable matter per 100,000 of water. Probably at least two trees per acre have rot holes with mosquito larvae and about 14 per cent. of the *Dracaena* plants are infested. Holes in shaded granite boulders are another common source of sylvan mosquitos. Surveys of adjacent forest areas at different altitudes revealed striking changes in the mosquito fauna. *A. pulchrithorax*, Edw., is the prevalent species at 6,500 ft. and *A. kapretwae*, Edw., at 8,500 ft., whilst, in general, *A. africanus*, *A. aegypti* and *A. bambusae*, Edw., appear to be widespread.

A study of the lists of mammals, trees and mosquitos indicates that the relict forest of Kaimosi contains numerous western species not found elsewhere so far to the east. Immunity tests carried out at Entebbe failed to demonstrate the presence of yellow fever in man or monkeys at Kaimosi. However, one monkey showed immunity from Semliki forest virus [*cf.* **34** 87] and one from either Japanese B or St. Louis encephalitis virus. The inhabitants suffer from malaria, transmitted by *Anopheles gambiae*, Giles, and onchocercosis (*Onchocerca volvulus* carried by *Simulium neavei*, Roub., 25 per cent. of which were infected, and the monkeys and fruit bats are infected with species of

Plasmodium. The Kaimosi forest from every standpoint, including climate, is suitable for the establishment of jungle yellow fever, and possible measures of control are briefly suggested.

Descriptions of the various stages of some of the mosquitos are given in an appendix.

ADLER (S.). **The Sandflies of Cyprus (Diptera).**—*Bull. ent. Res.* **36** pt. 4 pp. 497–511, 1 pl., 6 figs., 24 refs. London, 1946.

Collections of *Phlebotomus* were made in and near houses and stables in various parts of Cyprus between 10th August and 9th September 1944, and 2,000 examples were examined. Very few were taken in the stables, possibly because animals are kept in the open during the hot summer nights. Keys are given to the males (based on the terminalia) and females of the sandflies found, with morphological notes on most of them and descriptions of the new ones. They comprised *P. papatasii*, Scop., which was the commonest species and was caught mainly in and near houses, *P. sergenti*, Parr., *P. alexandri*, Sinton, *P. tobbi*, Adl. & Thdr., which appeared to be the commonest member of the *major* group, a race of *P. chinensis*, Newst., *P. perfiliewi*, Parr. (*macedonicus*, Adl. & Thdr.), of which a single female was found, *P. larroussei*, Lgn. & Nitzu., *P. fallax* var. *cyprioticus*, n., *P. azizi*, sp. n., and a melanic form of *P. minutus* var. *parroti*, Adl. & Thdr., as well as the typical form.

Human visceral leishmaniasis has been known in Cyprus since 1935, and canine general leishmaniasis is common. In one dog, the skin infection was so heavy that one out of 15 females of *P. papatasii* acquired a stomach infection after feeding on it [*cf. R.A.E.*, B **23** 123]. *P. tobbi*, which has been infected experimentally [**19** 63; **23** 123], and the local race of *P. chinensis* are considered possible carriers. The morphological characters of the various races of *P. chinensis* are discussed, as it is the vector of visceral leishmaniasis in China [**30** 129] and it has been found in other groups of sandflies that slight morphological differences may be accompanied by great differences in bionomics and ability to transmit disease. *P. perfiliewi* is zoophilous and is usually associated with a low incidence of visceral leishmaniasis in man and a high incidence in dogs. A striking example of this is seen in the Valley of Jezreel [**23** 123], where the sandfly is abundant and the disease common in dogs. The difficulty of distinguishing females of *P. perfiliewi* from other members of the *major* group is discussed, and a survey is made of the characters of the distinct geographical races of *P. major*, Annan., which differ in many morphological details and in some cases in feeding habits. As in the case of *P. chinensis*, differences in races of *P. major* may be of importance in the epidemiology of visceral leishmaniasis. There is as yet no evidence for associating *P. major* with visceral leishmaniasis in India, whereas in Sicily it has a higher infection rate when fed on infected dogs than even *P. perniciosus*, Newst. [**23** 123], and the local race is the only carrier of the disease in Crete [*cf.* **26** 256].

[BADANIN (N.) & BADANINA (A.).] **Бадании (Н.) и Бадании (А.). Hypodermatosis of Horses. (Preliminary Communication.)** [*In Russian.*]—*Proc. Lenin Acad. agric. Sci. U.S.S.R.* **10** no. 3 pp. 32–33. Moscow, 1945.

Warbles caused by *Hypoderma* were observed on three horses in Samarkand in March and April 1944. Each horse had one warble containing a larva and two or three from which the larvae had emerged. The three larvae that remained were removed and proved to be morphologically identical; the size of one of them is given. The warbles resembled those caused in cattle and showed a tendency to turn into abscesses when subjected to pressure from

harness. Previous records of infestation of horses by *Hypoderma* in the Russian literature [*cf. R.A.E.*, B **33** 17] are reviewed.

Control of the Diseases of Sheep and Goats. [*In Russian.*]—*Proc. Lenin Acad. agric. Sci. U.S.S.R.* **10** no. 3 pp. 45–48. Moscow, 1945.

This is a summary of reports read at a veterinary conference in Kirghizia in 1944 and includes a note (p. 47) in which L. S. Zil'ber states that the virus of louping ill of sheep was isolated from examples of *Ixodes ricinus*, L., in the Republic of White Russia (Belorussiya) by M. P. Chumakov [*cf. R.A.E.*, B **31** 70], who found that it caused symptoms in sheep somewhat similar to those caused by the virus of the tick-borne encephalitis of the Russian Far East. Zil'ber, however, found it to cause different symptoms in sheep and concluded that it was the virus of louping ill [*cf.* **33** 110].

[Lagereva (M. G.).] **Лагерева (М. Г.). Methods and Means of Treating Mange in agricultural Animals.** [*In Russian.*]—*Veterinariya* **22** no. 8–9 p. 24–25. Moscow, 1945.

The results of experiments by veterinary workers in various parts of the Russian Union are summarised. I. E. Ivanov freed horses from unspecified mange mites by means of an emulsion prepared by dissolving 2 lb. soap in 1 gal. hot water and gradually stirring in ½ gal. turpentine or kerosene and 1 gal. warm water. The emulsion was rubbed with a brush or a bunch of bast into the affected parts and the adjoining areas, and each horse was then subjected to a steam bath in a special chamber for 40–50 minutes at a temperature of 50–55°C. [122–131°F.], washed with warm water and dried in a drying chamber. Hair grew on the affected parts of the body after three treatments at intervals of 4–5 days. Horse cloths and harness were disinfected in the same chamber by exposure to turpentine vapour at a temperature of 60°C. [140°F.] for 40–50 minutes. Cattle infested by larvae of warble-flies [*Hypoderma*] were successfully treated in the same way with the turpentine emulsion, the exposure in the steam-bath lasting 40–45 minutes at 45–50°C. [113–122°F.]. The larvae began to abandon the warbles while the animals were being washed with warm water after the steam bath, and all had left 4–5 days later. Cattle were also freed from infestation by a decoction of 1 lb. makhorka tobacco [*Nicotiana rustica*] boiled for an hour in 5 gals. lye prepared by boiling 1 part ash in 2 parts water for an hour; the liquid was cooled and filtered and brushed into the backs of the animals. The larvae left in 4–5 days, and the orifices healed rapidly.

A. Z. Shakirov found that mange in sheep was eliminated by shearing them and then dipping them three times at intervals of a week for three minutes in 3½–4 per cent. creolin at a temperature of 40°C. [104°F.]. After each dip the sheep were transferred to fresh pasture. Sheds and the implements with which the sheep are handled were cleaned and treated with hot lye, and the walls were whitewashed or disinfected with 2 per cent. formaldehyde. Dipping should be carried out three times in the season, in spring, summer and autumn.

Investigations by K. F. Lamikhov showed that mange mites die within 24 hours at −7·5°C. [18·5°F.]. At temperatures between −12·5 and −14·8°C. [9·5–5·4°F.] and −21·5 and −23°C. [−6·7 to −9·4°F.], examples of *Psoroptes* died in 6 and 4 hours, respectively, whereas they survived exposure for 24 hours to temperatures between −2·2 and −6·6°C. [28–20·1°F.]. Horses did not become infested when mites and scabs that had been kept for 20–24 hours at or below −8·6°C. [16·5°F.] were placed on their skin, or when infested harness was used after it had been exposed to a temperature between −10 and −16°C. [14–3·2°F.] for 45 hours.

A. Muzuichenko successfully treated mange in horses by two applications of a mixture of diesel oil and vegetable oil rubbed with a brush or cloth over

the affected areas after they had been washed and clipped. The mixture contained 20 per cent. vegetable oil for the first application and 30 per cent. for the second, which was made a week later.

[Bogdanov (N. N.).] **Богданов (Н. Н.). The Duration of the Life of Horse Mange Mites off the Host.** [*In Russian.*]—*Veterinariya* **22** no. 10 pp. 23–24, 1 ref. Moscow, 1945.

Russian instructions for the control of mange in domestic animals prescribe the closing of used pastures, watering places and premises for two months in summer or one in winter as it is considered that all the mange mites and their eggs will die during these periods. Since, however, the author found in preliminary experiments that mange mites from horses can survive off their host for three months, he took three samples of scrapings from the skin of horses infested by *Sarcoptes caballi*, Oudm. (*equi*, Gerl.) on 2nd June 1943 and placed them in containers each formed by two petri dishes. Two of the containers were sealed with wax and all three were tightly packed in paper and kept until 1st May 1945. The wax on the two sealed containers was intact, and all three were found to contain living examples of both sexes and eggs of *S. caballi*. In contrast to what is observed in fresh scrapings, the males predominated ; they tried to hide when exposed to light, but were very active in diffused light. All the females had died by 4th May, after being kept at a mean day temperature of 12·6°C. [about 55°F.] and a relative humidity of 77 per cent., and only three living males were found on 6th May.

[Alikaev (V. A.).] **Аликаев (В. А.). The acaricidal, bactericidal and toxic Properties of Emulsions of Tar Oils.** [*In Russian.*]—*Veterinariya* **22** no. 10 pp. 39–42. Moscow, 1945.

With a view to finding a substitute for creolin against mange mites on domestic animals, laboratory experiments were carried out in 1942–43 with various tar oils obtained as by-products of the dry distillation of Siberian coal. A homogeneous fraction boiling within a range of 180–220°C. was selected, and was treated with various solutions of soft soap and sodium hydroxide in order to obtain an emulsion that would be stable when diluted to contain 2–4 per cent. oil. The method finally evolved was to heat 60 parts of a 10 per cent. solution of soft soap to boiling point, let it cool a little, add 14 parts of a 5 per cent. solution of sodium hydroxide, and then gradually stir in 100 parts tar oil.

In preliminary laboratory tests, complete mortality of mites of the genus *Sarcoptes* taken from horses and sheep was given by exposure for two minutes to emulsions containing 2 per cent. tar oil at a temperature of 40°C. [104°F.], and the emulsion was also shown to possess bactericidal properties. At concentrations of 2–3 per cent., it proved harmless when applied externally to mice or sheep, but one of four sheep treated with a 5 per cent. emulsion showed a rise in temperature. Applications of unemulsified tar oil resulted in skin irritation and a high temperature for five days. Very dilute emulsions administered internally to sheep proved harmless, and it was concluded that tar-oil emulsions are as safe in use as creolin from the Donetz coalfield.

In a practical test, a horse severely infested with *Sarcoptes* [*caballi*, Oudm.] was washed three times at successive intervals of four and eight days with an emulsion containing 2·5 per cent. tar oil, the liquid being applied to the whole body surface after the long hair was clipped. The horse was washed with hot water and soft soap before each treatment and was fed well and kept from work. No mites were found in scrapings from its skin eight days after the last treatment, and the lesions healed.

Cragg (J. B.). **Sheep Maggots.**—*Agriculture* **52** no. 4 pp. 161–164, 2 refs. London, 1945.

The relative importance of the different species of blowflies that infest sheep in Britain [*cf. R.A.E.*, B **31** 150] and the factors that favour infestation are briefly reviewed, and notes are given on control measures. Dipping is considered the most important of these, but it is emphasised that using a dip at a concentration higher than that recommended will injure the skin and so encourage infestation and that a fouled bath is a common cause of strike. Dipping does not give protection for more than three weeks. Crutching, which was shown to be of value in experiments in two seasons [**29** 176 ; **32** 36], is highly recommended. Lambs should be crutched at shearing time and those of lowland breeds again a few weeks later if blowflies are common. As a dressing for infested sheep, a mixture of Lysol, carbon tetrachloride, kerosene and steam-distilled pine-tar oil (5 : 4 : 9 : 2 by volume) [*cf.* **29** 177], used at a concentration of 20 per cent. in water, has given good results in North Wales. The wool should first be clipped from the affected area, and dressing should also be poured over the clippings to kill the larvae in them. If the soil of the pen in which the sheep are dressed is ploughed up to allow birds to destroy the over-wintering maggots that escaped destruction, the surrounding strip of untrodden land should also be ploughed, as it is there rather than in the pens that the larvae congregate. Promising results in preventing infestation have been obtained with a dip containing DDT, which is toxic to blowflies that settle on the sheep, but further experimental work is necessary before it can be recommended.

Annand (P. N.). **Report of the Chief of the Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, 19[43-]44.**—56 pp. Washington, D.C., U.S. Dep. Agric., 1945.

All Simuliids were eliminated for at least a month from 20 acres of woodland in Pennsylvania by the application of DDT at the rate of 5 lb. per acre in a concentrated spray released from an aeroplane for the control of the gipsy moth [*Lymantria dispar*, L.]. The spray was applied on 3rd May 1944, when foliage was just beginning to appear, and settled as a fine mist over trees, undergrowth and the forest floor. After it had dried, a fine crystalline deposit of DDT remained on all exposed parts of the forest. A spray containing 1 per cent. DDT applied to cattle killed all horn flies [*Siphona* (*Lyperosia*) *irritans*, L.] that alighted on them for one week, and spraying range cattle with an emulsion containing 0·2 per cent. DDT, applied at the rate of 1 U.S. gal. per 12 animals, kept them almost free of flies for the same period [*cf. R.A.E.*, B **32** 204]. Finely ground tripoli earth, volcanic ash and pyrophyllite were much more effective than talc or sulphur [*cf.* **33** 151] as diluents for rotenone-bearing powders for the treatment of cattle infested with cattle grubs [*Hypoderma*], as they penetrate the hair better. Their use to economise rotenone is recommended. Sprays containing only finely ground cubé or derris root in water also killed large numbers of the larvae, and when applied at a pressure of 400 lb. or more, gave better results than sprays in which wettable sulphur or a wetting agent was included. The addition of a small amount of sodium lauryl sulphate somewhat enhanced the effectiveness of sprays applied at a low pressure. A dip composed of 2·5 lb. cubé powder (containing 5 per cent. rotenone) in 1,000 U.S. gals. water killed all motile stages of the short-nosed cattle louse *Haematopinus eurysternus*, Nitzsch], and the addition of 100 lb. wettable sulphur made the dip effective for use a second time two weeks after the first. A dip containing 5 lb. cubé without sulphur or with only 50 lb. sulphur did not kill all the lice when it was kept for a second treatment, and wettable sulphur at 150 lb. per 1,000 U.S. gals. water without rotenone was not satisfactory. As little as 0·06 per cent. DDT in water suspension gave complete kill of the motile stages of all species of cattle lice.

For killing ticks in vegetation, a spray containing 5 per cent. DDT was very effective. An emulsion caused no injury to the vegetation, and when applied at the rate of 1 lb. DDT per acre, controlled the ticks for about six weeks. Large numbers of the spinose ear tick [*Otobius megnini*, Dugès] were killed by the spraying of salt troughs and the areas under them [*cf.* **33** 128] with equal parts of kerosene and used motor oil, and the application of a non-drying adhesive containing an insecticide to the ears of cattle, sheep and goats gave protection for 90–120 days. The two measures combined caused a marked reduction in the population of the tick in pastures.

SMITH (G. E.). **Practical Field Application of DDT for Malaria Control.**— 27 pp. multigraph, 6 refs. Washington, D.C., U.N.R.R.A. Hlth. Div. Sanit. Sect., 1945.

The properties and insecticidal action of 2,2-bis (parachlorphenyl) -1,1,1-trichlorethane (DDT) are briefly described, and examples are given of inter-specific variations in the habits of Anophelines in various countries that have a bearing on control. The solubility of DDT at normal temperature in some of the most useful solvents is shown, and formulae are given for preparing solutions, concentrates (solutions in a good solvent with the addition of an emulsifier) and dusts containing different percentages of DDT in quantities suitable for dispersal in different ways. Polymethylnaphthalenes (Velsicols or Sovasols) are very good solvents for DDT. Oil solutions are useful as larvicides, but are not very suitable for spraying to obtain a toxic residue indoors as they involve a risk of fire, dry slowly and spot many surfaces. Emulsions prepared by diluting concentrates with water at the place of application are considered preferable against both adults and larvae, as they have all the desirable qualities of oil solutions without the objectionable characteristics and they save having to obtain or transport large quantities of oil. Dusts are difficult to prepare, as the pure DDT powder is rather sticky and heavy grinding equipment is necessary for mixing. Descriptions are given of methods of preparing solutions and concentrates and of a mechanical mixer by which about 500 lb. DDT can be mixed in an hour using the formula 125 lb. DDT, 31·5 U.S. gals. xylene and, if a concentrate for emulsification is required, 2 U.S. gals. Triton X–100.

Equipment and methods considered suitable for dispersal are discussed, and tables are given showing the results obtained when DDT is applied at various rates and in various forms for the control of larvae or adults. Against larvae, 0·1 lb. DDT per acre gave good initial kill when applied in emulsion, solution or dust, but lost its effectiveness after a week. Results were similar for 0·5 lb. applied as a dust, but 0·2 and 0·4 lb. applied in liquids remained effective for two weeks. The dosage to be applied varies from 0·1 to 0·5 lb. DDT per acre according to field conditions. Oil solutions and water emulsions were very toxic to all aquatic life at 0·5 lb. and dust at 1 lb. per acre. Care must be taken that the DDT reaches the entire surface of the water, particularly where floatage is likely to prevent its spreading to sheltered areas where breeding may be intense. The use of a small hand sprayer applying a 5 per cent. solution or emulsion is recommended for treating specific restricted breeding areas as they are found. If it is necessary to use an air-pressure or knapsack sprayer, a 1 per cent. solution or emulsion should be applied at the rate of 5 U.S. quarts per acre, but this method is cumbersome. A 1 per cent. dust may be applied with an ordinary Paris-green hand-duster at the rate of 10 lb. per acre, but other methods of application are preferable. Trials involving the addition of DDT to irrigation water at its source were not successful. The recommended rate for residual sprays in houses for control of adult mosquitos is 100–200 mg.

DDT per sq. ft. Higher rates do not give better results. The 100-mg. dosage applied to walls and ceilings is stated to be effective for 3–5 months.

In 1943 and 1944, the Tennessee Valley Authority investigated the application of DDT dusts from large aeroplanes, but it was not found possible to distribute satisfactorily a dust containing more than 5 per cent. DDT, on account of its stickiness, and this was objectionable because of the high percentage of inert diluent to be carried. A small aeroplane distributed a 5 per cent. oil solution at 0·1–0·2 lb. per acre with an effective swath width of 40 ft., but was suitable only for small areas on account of its limited capacity and flying time. The large aeroplane used for dusting was therefore equipped with a spray unit for large-scale operations. This was more satisfactory, but a better solvent was needed and Velsicol NR–70 was adopted. A 15-40 per cent. solution in this solvent controlled larvae over swath widths of 200–300 ft. when applied at 0·1 lb. DDT per acre, but the spray formed droplets 100–500 microns in diameter and did not form a complete surface film at this rate of application. To break the spray into finer droplets, aeroplanes equipped with exhaust generators to produce thermal aerosols were used, the solution being injected into the exhaust manifold. After extensive experiments, a satisfactory method was developed for producing an aerosol in which 90 per cent. of the droplets had diameters of 5–100 microns. The aerosol, which was quite visible, was rapidly carried to the water surface by the down draught from the propeller, and vegetation was effectively penetrated. Over 90 per cent. of the larvae have been killed over swaths as wide as 300 ft. at rates of application as low as 0·04 lb. DDT per acre. A thermal aerosol distributed at 0·5 lb. DDT per acre is effective against the adults, and leaves a deposit that persists for some time on vegetation, killing newly emerged mosquitos when they touch it. Some precautions that should be taken in using DDT are described.

MANDEKOS (A. G.). **D.D.T. (Neocid, Gesarol, Gix). A new Insecticide which will revolutionize the Methods of controlling various Diseases transmitted by Insects.** [*In Greek.*]—*Hellen. iatr.* repr. 16 pp., 7 refs. Salonica, 1945. (With a Summary in English.)

From laboratory and field experiments carried out in Greece in 1943 and 1944, it is concluded that Neocide (5 per cent. DDT in talc) is effective against larvae and adults, but not eggs or pupae, of *Anopheles* and *Culex*. Contact with the powder or with a suspension of 1–6 gm. Neocide in 1,000 cc. water with the addition of 2 cc. kerosene caused adults and larvae to die in 3–4 hours. Ceilings and walls of bedrooms or stables can be kept free from mosquitos for at least five weeks by the application of 1 gm. Neocide in 2 cc. kerosene and 18 cc. water per sq. metre [4·65 mg. DDT per sq. ft.]. A suspension of 2 gm. Neocide and 2 cc. kerosene in 1,000 cc. water applied at 70 cc. (7 mg. DDT) per sq. metre [about 1 oz. DDT per acre] to breeding places of races of *Anopheles maculipennis*, Mg., including var. *sacharovi*, Favr (*elutus*, Edw.), gives very good initial kill, but an application must be made every week. In the fast-flowing streams in which larvae of *A. superpictus*, Grassi, occur, better results are obtained if a larger quantity of Neocide is used (160 cc. of a suspension containing 5 gm. Neocide and 10 cc. kerosene per 1,000 cc. water). In 1944, this dosage was used in breeding places in Salonica, and the total number of Anophelines taken in ten catching stations in the city and its outskirts was 85, compared with an average of 89·1 and a range from year to year of 38·8 to 166·5 in 1939–43, when Paris green was applied by a dustless method [*R.A.E.*, B **34** 66]. Comparative figures are given showing the amounts of DDT required per unit area for spraying walls or treating breeding places by the methods of application described by the author and by Smith [see preceding paper].

VARGAS (L.). **Algunas** [Some] **consideraciones sobre** *Anopheles occidentalis* **Dyar y Knab, 1906.**—*Rev. Inst. Salub. Enferm. trop.* **5** no. 4 pp. 215–220, 2 figs., 3 refs. Mexico, D.F., 1944. (With a Summary in English.)

The author describes in detail from 12 larval skins received from California the fourth-instar larva of *Anopheles maculipennis* var. *occidentalis*, D. & K., which he treats as a distinct species, giving notes on characters distinguishing it from various allied forms. He also discusses characters of the phallosome tentatively thought to distinguish the males of *A. m.* var. *occidentalis* from those of *A. earlei*, Vargas [*cf. R.A.E.*, B **32** 78] and gives a list of 16 States from Washington and Oregon to Maine and Connecticut from which the latter has been recorded under the name of *A. maculipennis*, Mg., or *A. m. occidentalis* [*cf.* **30** 154] and one of six others in which he thinks it must occur. It has not been found in California, but its range overlaps with that of *A. m. occidentalis* in other parts of the Pacific slope.

TOVAR (R. M.). **Existencia del** *Dermacentor parumapertus* **Neumann,** *Amblyomma inornatum* **Banks y** *Amblyomma maculatum* **Koch en México.**—*Rev. Inst. Salub. Enferm. trop.* **5** no. 4 pp. 293–295, 5 refs. Mexico, D.F., 1944. (With a Summary in English.)

Dermacentor parumapertus, Neum., and *Amblyomma inornatum*, Banks, are recorded for the first time from Mexico. Both were taken on hares, the former in Hidalgo and the latter in Morelos. Experiments have shown that *D. parumapertus* can transmit tularaemia and Rocky Mountain spotted fever experimentally and preserve infection with the latter from one generation to the next. Examination of 20 females of *A. inornatum* for rickettsiae and tularaemia bacteria yielded negative results. An engorged female of *A. maculatum*, Koch, was found on a dog in Sinaloa in the region in which a spotted fever [*R.A.E.*, B **32** 78] known as choix fever has been observed.

ORTIZ MARIOTTE (C.), BUSTAMANTE (M. E.) & VARELA (G.). **Hallazgo del** *Rhipicephalus sanguineus* **Latreille infectado naturalmente con fiebre manchada de las Montañas Rocosas en Sonora (México).** [Finding of *R. sanguineus* naturally infected with Rocky Mountain Spotted Fever in Sonora, Mexico.]—*Rev. Inst. Salub. Enferm. trop.* **5** no. 4 pp. 297–300, 1 graph, 11 refs. Mexico, D.F., 1944. (With a Summary in English.)

In an attempt to find the Mexican vector of spotted fever, ticks were collected from houses and domestic and wild animals in the south and north, respectively, of the States of Sonora and Sinaloa [*cf. R.A.E.*, B **32** 78], and suspensions of batches of 2–45 of them were injected into guineapigs. Some had previously been made to feed on healthy guineapigs, and others had fed recently in nature. The species represented were *Rhipicephalus sanguineus*, Latr., *B[oophilus] annulatus*, Say, *A[rgas] persicus*, Oken, and *O[rnithodoros] coriaceus*, Koch. An infective agent was thus isolated from a batch of *R. sanguineus* taken on a dog in Chinal, Sonora, where cases of spotted fever had occurred in man in various years. It showed cross immunity with a strain isolated from a case of spotted fever from Sinaloa but not with typhus. References in the literature to *R. sanguineus* as a vector of rickettsia diseases and the dog as a reservoir of them are reviewed. *R. sanguineus* is abundant in the parts of Mexico where spotted fever has occurred and sometimes bites man.

MAZZA (S.), TALICE (R. V.) & JÖRG (M. E.). **Investigaciones sobre Triatominae. Sobre** *Triatoma* (*Neotriatoma*) *circummaculata* **y** *Triatoma* (*Eutriatoma*) *rubrovaria*.—*Publ. Misión Estud. Pat. reg. argent. Jujuy, Univ. B. Aires* no. 62, 52 pp., 2 col. pls., 34 figs. Buenos Aires, 1942.

The original descriptions of *Triatoma* (*Neotriatoma*) *circummaculata*, Stål, and *T.* (*Eutriatoma*) *rubrovaria*, Blanch, are given in Spanish, together with

supplementary descriptions of the former by Del Ponte and of the latter by Stål, Del Ponte and Lent [*R.A.E.*, B **30** 192], additional morphological data and illustrations of both prepared from the authors' personal observations and designed to facilitate specific identification, descriptions of the first-instar nymph of *T. circummaculata* and the egg and nymphs of various instars of *T. rubrovaria*, and characters distinguishing *T. circummaculata* from the closely allied *T.* (*N.*) *limai*, Del Ponte. *T. circummaculata* occurs in Uruguay and Argentina, but is apparently more abundant in the former country, where it was once found infected with *Trypanosoma* (*Schizotrypanum*) *cruzi*. It is a rural species, living under stones on rocky hills, often far from dwellings. *Triatoma rubrovaria* occurs in Uruguay, Argentina, Brazil and Chile and possibly also in Java [*cf.* **12** 63], though [W. K.] Mertens, [E. P.] Snijders and [C.] Bonne were unable to confirm its occurrence there, having found only *T. rubrofasciata*, Deg. [*cf.* **29** 165, etc.].

Mills (H. B.), Callenbach (J. A.) & Reinhardt (J. F.). **Maggots attacking a Human** (*Wohlfahrtia meigeni* **Schin.**).—*Bull. Mont. agric. Exp. Sta.* no. 425 (30th Rep. St. Ent. 1943–44) pp. 23–24, 2 refs. Bozeman, Mont., 1945.

A fly reared from one of several larvae found protruding from inflamed areas on the skin of an infant in Montana in July 1943 was identified as *Wohlfahrtia meigeni*, Schin. [*cf. R.A.E.*, B **26** 79; **32** 107]. This is thought to be the first record of the fly attacking man in Montana.

Dikmans (G.). **Check List of the internal and external Animal Parasites of domestic Animals in North America (United States and Possessions and Canada).**—*Amer. J. vet. Res.* **6** no. 21 pp. 211–241, 72 refs. Chicago, Ill., 1945.

This check list of animal parasites in North America and the Possessions of the United States elsewhere is in the form of tables dealing, respectively, with the internal and external parasites of horses, mules and donkeys, cattle, pigs, sheep and goats, dogs and cats, and poultry. The information given in each table comprises the groups and scientific and popular names of the parasites, the situation they occupy in or on the host, their intermediate hosts, if any, and their geographical distribution in the area on the host in question, so far as this is known. It is pointed out, however, that knowledge on the distribution of animal parasites within the United States is still incomplete, and possible sources of error in information on this subject are discussed.

Portman (R. W.). **Pasture Management kills Lone Star Ticks.**—*Circ. Missouri agric. Exp. Sta.* no. 297, 4 pp., 4 figs. Columbia, Mo., 1945.

Recent study has shown that populations of the lone star tick [*Amblyomma americanum*, L.] in the wooded pastures of southern Missouri can be greatly reduced by appropriate pasture management. The tick, which is the only important one attacking cattle and man in the region in summer, occurs on pasture on which animals graze all the year round. The overwintered adults seek a host on the first warm days of spring. The males feed for a short time before pairing, and after it, the females usually feed for about a week. When fully fed, they drop, digest their blood meal, oviposit and die. One female may lay 4,000 eggs. The adults are most active during late May and early June. The eggs begin to hatch about 15th June, and the larvae crawl up blades of grass and wait for a host. This may be a small rodent or one of the larger animals. They attach anywhere on the hide and feed for 2–4 days. They may be found until the first heavy frost, but are most plentiful in the middle of August. They cannot survive the winter if they have not found a host. The engorged

larvae drop from their hosts to digest their meal and moult, the process taking about two weeks. The nymphs can live through one winter without feeding. They attack small rodents or larger animals about the middle of April, and feed for about three days, then drop, digest and moult and usually reach the adult stage in three weeks.

If two fenced pastures are available, one can be practically cleared of ticks by keeping cattle out of it from 15th June until the first severe frost, for the females will die after oviposition and the larvae will die through lack of food. Only a few adults that matured from the previous season's nymphs before the cattle were removed will remain. By following this procedure for two successive years and occasionally thereafter, the ticks become so reduced in numbers that they are no longer of importance. Dipping, which was enforced in the past for the control of a one-host tick [*Boophilus annulatus*, Say], is not effective against *A. americanum* as it is on the host for a short time only. An additional measure that may be used to supplement pasture management is to spray the animals or preferably swab their flanks and the region round the udder with a commercial stock fly-spray, which usually contains extracts of pyrethrum or derris. Doing this several times will not only reduce the number of ticks but also repel flies.

SAPRE (S. N.). **Some Observations on the Life-history of the Dog Tick** *Rhipicephalus sanguineus* **(Latreille) at Mukteswar.**—*Indian J. vet. Sci.* **14** pt. 2 pp. 111–112, 3 refs. Delhi, 1945.

The study described was made at Mukteswar, United Provinces, at an altitude of 7,500 ft., mostly with material received from Bombay and Baroda, as very few individuals of *Rhipicephalus sanguineus*, Latr., could be collected from local dogs. Observations on non-parasitic stages were made at 22°C. [71·6°F.] and a relative humidity of 80–90 per cent. The females began to oviposit 3–6 days after leaving the host, laid 1,485–3,556 eggs in 14–18 days and survived for 2–14 days after oviposition. The egg stage from the beginning of oviposition to the hatching of the first larva lasted 25–40 days. The parasitic periods of larvae, nymphs and adults on dogs were 3–6, 5–9 and 9–15 days, and the non-parasitic periods of larvae and nymphs were 24–30 and 30–43 days, respectively. The length of the parasitic periods was not affected by temperature.

SENIOR-WHITE (R.). **Some Notes on the Life-history of** *Musca planiceps* **Wied.** —*Indian J. vet. Sci.* **14** pt. 2 pp. 123–125, 1 ref. Delhi, 1945.

The results are given of observations on *Musca planiceps*, Wied., a blood-sucking larviparous Muscid, made over 20 years ago in the Ceylon foot-hills at a height of 1,300 ft. For eight months, fresh cow-dung was exposed fortnightly for 24 hours and then taken to the laboratory. A list is given of the Diptera that emerged, showing their seasonal occurrence and prevalence. *Musca conducens*, Wlk., formed nearly 92 per cent. of the total and *M. planiceps*, the next most abundant species, formed 32 per cent. of the remainder. Both were taken in every month. The newly emerged females of *M. planiceps* contain only immature eggs. Larvae are deposited early in the third instar. Evidence is given that as soon as a larva is deposited, the uterus receives an egg ready to hatch from one ovary whilst the other completes the development of the next egg. The act of larviposition is described. The larvae burrow into the dung on which they are deposited and feed on it ; they usually feed for about two days, but one fed for eight. Pupation occurs in earth beneath the dung, and the pupal stage lasts 7–17 days. Emergence usually takes place before noon, and occurs over a period of three days from dung exposed for 24 hours. Only a few females emerge on the first day and only males on the third.

Only once was a resting male taken containing fresh blood, and a male was once seen on a bull but was not observed to bite. This is the only occasion on which an adult of either sex was seen on cattle, and females placed on a calf refused to feed, but 56 per cent. of all captured females taken over six months contained blood in the gut, and a specimen of blood was found to be bovine. Dissection of flies taken in the early morning showed the blood always in an advanced stage of digestion. Attempts to feed flies in captivity on human blood exuding from a prick, raw meat exuding serum, sugar solution and fresh cow-dung all failed, though dung is sucked at in nature. It is difficult to find adults during the day. About an hour before dusk, both sexes begin to settle on blades of grass near cattle in the proportion of seven females to one male, though the sexes are produced in approximately equal numbers. Data are given showing that females feed at all stages of gestation.

M. planiceps is parasitised by the Staphylinid, *Aleochara trivialis*, Kraatz, the larvae of which emerge from puparia at the same time as flies of the same generation or a day or two later and immediately pupate in earth in a webbed soil cocoon. The pupal period lasts about 16 days. The percentage of puparia parasitised may vary from 10 in June to 78 in November. A male of *M. planiceps*, marked by cutting off part of a leg and recaptured 96 hours after release in October, showed the fungus, *Stigmatomyces baeri*, on the affected leg. The fungus was practically mature.

Blanc (G.) & Baltazard (M.). **Contribution à l'étude du comportement de certains bacilles pathogènes chez la puce du rat, *Xenopsylla cheopis*. Les bacilles paratyphiques B.**—*C. R. Soc. Biol.* **138** no. 19–20 pp. 809–810, 1 ref. Paris, 1945. **Le bacille de la pseudo-tuberculose des rongeurs.**—*T.c.* pp. 811–812.

In the experiments described in the first paper, *Xenopsylla cheopis*, Roths., regularly became infected with *Salmonella suipestifer* after feeding on infected guineapigs or on rabbits in which temporary bacteraemia had been induced by massive intravenous injection of the bacillus. The fleas remained infected for at least 40 days and probably throughout life. The organism multiplied in their digestive tract and passed into the excreta, in which it could be kept in a dry condition for at least seven months. Guineapigs bitten by infected fleas contracted either a febrile illness that developed after an incubation period of about ten days and generally caused their death or an apyretic but septicaemic infection. The latter was, however, usually transformed into a fatal febrile infection if the guineapigs were injured in various ways. It is thought that there are probably also human carriers of *Salmonella* who have infection in the blood without showing evidence of disease. *X. cheopis* could be infected with *S. schottmülleri* only as a result of biting a rabbit with experimentally induced bacteraemia, but the infection that developed in it was comparable in every way with that obtained with *S. suipestifer*.

It is recorded in the second paper that *X. cheopis* was infected with the bacillus of pseudotuberculosis of rodents in the same ways as it was with *S. suipestifer*. The organism persisted in the fleas for up to 35 days, and was transmitted by inoculation of suspensions of them, but not by their bites.

Trypanosomiasis Committee of Southern Rhodesia. **The Scientific Basis of the Control of *Glossina morsitans* by Game Destruction.**—*Rhod. agric. J.* **42** no. 2 pp. 124–128; also as *Bull. Minist. Agric. S. Rhod.* no. 1303, 6 pp. Salisbury, S. Rhod., 1945.

Measures have been taken in Southern Rhodesia during the past 25 years to create and maintain game-free zones in order to prevent the extension and ultimately cause the retrogression of *Glossina morsitans*, Westw. [*cf. R.A.E.*, B **30** 8, etc.]. The regular hosts of *G. morsitans* are the larger grazing and browsing mammals available all the year round, and it also has occasional

hosts, which are nocturnal, exceptionally active, migratory or seasonally hidden by long grass. It must obtain meals at regular intervals to replace water lost by evaporation. The extermination of most of its usual hosts deprives it of opportunities of obtaining regular meals and forces it to expend energy seeking other sources of food and thus lose much moisture, so that the death rate rises far above normal and females may abort. To eliminate *G. morsitans* from an area, therefore, it is not necessary to exterminate every species of animal on which it can feed ; it is sufficient to eliminate those that provide a dependable source of food throughout the year. When this has been done, the fly cannot support life when grass is high and dense. As *G. pallidipes*, Aust., can find its prey even in thick vegetation, game destruction has to be very drastic to be successful by itself in eliminating this species. If a zone that has been freed of *G. morsitans* has its ends in fly-free country or is fifty miles or more long, game can be allowed to re-enter it by moving the shooting zone forward into the fly belt without increasing its width (10–20 miles). The desirability of doing this is discussed. It is pointed out that the presence of much game in a cattle area results in loss of pasturage and increases the difficulty of controlling tick-borne and other diseases of stock, and that certain species destroy crops or are a menace to human life.

Bohart (R. M.) & Ingram (R. L.). **Four new Species of Mosquitoes from Okinawa (Diptera : Culicidae).**—*J. Wash. Acad. Sci.* **36** no. 2 pp. 46–52, 24 figs. Menasha, Wis., 1946.

Descriptions are given of the egg, larva and adult female of *Anopheles saperoi*, sp. n., and the larva and adults of both sexes of *Uranotaenia stonei*, sp. n., *Aëdes riversi*, sp. n., and *A. downsi*, sp. n. The finding of *A. riversi* in Okinawa represents an extension northward of the known distribution of the species of *Aëdes* belonging to the *scutellaris* group, which had previously been known to occur only as far north as Saipan in the Marianas Islands [*R.A.E.*, B **34** 38].

Nájera [Angulo] (L.). **La *Gambusia* de Canarias.** [The *Gambusia* of the Canary Islands.]—*Bol. Soc. esp. Hist. nat.* **42** pp. 565–574, 6 figs., 8 refs. Madrid, 1944.

In view of an outbreak of malaria on the island of Grand Canary in 1943, it was thought desirable to introduce *Gambusia holbrooki* from Spain, where it has proved of considerable value against Anopheline larvae since 1921, when it was first liberated. It was found, however, that fish of this genus had already been introduced into Grand Canary from Teneriffe in 1943, though their specific identity was unknown. The author discusses at some length characters distinguishing *G. holbrooki* and *G. affinis* and concludes that the species concerned was the former.

Papers noticed by Title only.

Hoffmann M[endizabal] (A.). *Neoschoengastia nuñezi* **n. sp. (Acarina : Trombidiidae)** [from man and fowls in Mexico].—*Rev. Inst. Salub. Enferm. trop.* **5** no. 4 pp. 221–225, 4 figs., 6 refs. Mexico, D. F., 1944. (With a Summary in English.)

Vargas (L.). **Cuatro nuevas especies y otros datos sobre simúlidos de México.** [Four new Species and other Data on Mexican Simuliids.]—*Rev. Soc. mex. Hist. nat.* **6** no. 1–2 pp. 71–82, 6 pls., 12 refs. Mexico, D. F., 1945.

Fox (I.) & Hoffman (W. A.). **New neotropical biting Sandflies of the Genus *Culicoides* (Diptera : Ceratopogonidae)** [including *C. oliveri*, sp. n., attacking man in Haiti].—*Puerto Rico J. publ. Hlth* **20** no. 1 pp. 108–111, 5 figs., 1 ref. Brattleboro, Vt., 1944. (With a Translation in Spanish pp. 112–115.)

LLOYD (LL.). **Animal Life in Sewage Purification Processes.**—23 pp., 6 figs., 48 refs. Hampton-on-Thames, Inst. Sewage Purif., 1945.

This account of the fauna of sewage purification works is based mainly on experience gained during a period of 12 years at Knostrop, Leeds, and other towns in the West Riding of Yorkshire [*cf. R.A.E.*, B **32** 122, etc.] but also on information drawn from observations in other parts of the world. Most of the insects that occur in the sewage filters were found by the author breeding together in a flat bed of mud kept wet by seepage from a slightly polluted stream. The mud-flat, which is about four miles from the nearest sewage works, becomes covered with a thick layer of leaves each autumn, is continuously fed by falling vegetable débris and occasionally receives a little silt from floods of short duration. Disintegration is very slow. The insect fauna is abundant, and about 40 per cent. of the flies bred from the mud were species characteristic of the filters, including *Psychoda alternata*, Say, *P. severini*, Tonn., *P. cinerea*, Banks, *Metriocnemus longitarsus*, Goetgh., *M. hirticollis*, Staeg., *Spaniotoma minima*, Mg., *S. perennis*, Mg., and *Anisopus cinctus*, F. *Chironomus dorsalis*, Mg., which breeds below filters, was also present. There was a dense layer of small worms, including *Lumbricillus lineatus*, just below the surface of the mud. Other insects that bred abundantly in the mud-flat breed occasionally in the filters, but are not numerically successful there. Colonisation of the filters by the fauna of the flats is thus shown to have been selective. *A. cinctus*, the most unpleasant of the filter flies, breeds also in collections of decaying vegetable matter, in rot holes of trees and in house sinks, and the three species of *Psychoda* in house sinks. *P. severini* reproduces parthenogenetically in Britain, where it is represented by subsp. *parthenogenetica*, Tonn., and *P. alternata* and *P. cinerea* can mate in a confined space [*cf.* **26** 114], whereas other species of *Psychoda* occurring in the neighbourhood cannot. A knowledge of the alternative breeding places of the flies is desirable when fly nuisance is attributed to the filters [*cf.* **32** 139].

The protozoa that occur in the filters, and also in activated sludge, and the part they play in sewage purification are surveyed in the light of recent work, and the behaviour of worms is described with its bearing on the working of the filters. The strength of the sewage as expressed by the biochemical oxygen demand is shown to be the chief factor regulating variations in the species of flies produced in the filters, the greatest number of species occurring where the sewage is well balanced in origin and of medium strength as at Knostrop [**32** 122]. Prolonged resting of the filters was found to be adverse to *Metriocnemus* [**26** 114]. The seasonal incidence of the various flies and the causes of the fluctuations in abundance are discussed [*cf.* **26** 113; **29** 63; **30** 78; **31** 181]. Where the fauna is varied, the forces governing seasonal incidence are highly complicated. Competition amongst the organisms is important as limiting the output of the more offensive flies and also has some bearing on the behaviour of the filters [*cf.* **28** 150]. It is suggested that the grazing organisms deplete the active film below the desirable level in the warmer months but the acceleration of the purification by higher temperatures largely compensates for this, and a fairly uniform degree of purification through the year results. The advantages of the complete fauna in contrast to a restricted one are discussed, and some factors that limit variety of forms are given.

In some places the sewage is too strong for the mixed fauna, but where it is of medium strength or weak, control of *Psychoda* might be achieved by encouraging the breeding of *Metriocnemus*, for which conditions are most favourable when the topping medium is smooth and of 2–3 inch grade and the application of sewage at the rate of one million gallons per acre per day is continuous in daytime though it may stop at night. Under these conditions, there is also a fair density of *L. lineatus* but *Psychoda* breeds in very small numbers. With

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the topping medium of 1–2 inch grade and the same working conditions, *Metriocnemus* is sparser while the worm and species of *Psychoda* are denser. When it is necessary to control *Psychoda* mechanically, the enclosed filter is effective if fly baffles are fitted to all the vents. Flooding [**7** 24] is much practised in the United States. For chemical control, only chlorine and creosote [*cf.* **21** 243 ; **29** 63] have given good results. Bleaching powder (chloride of lime) is extensively used in South Africa, where *Psychoda* causes serious trouble. K. A. Murray recommends stopping the machine and spreading the powder at 1 cwt. to 500 sq. yards. Sewage is then applied for two minutes and the filter allowed to drain for 15 minutes. After the application of sewage and the draining have been repeated three times, the bed can be put into operation for 4–7 days depending on the length of the life-cycle of the fly at the time. Allison has found that the amount of bleaching powder required can be reduced by distributing coarse salt and letting the medium dry till night. This brings the larvae to the surface, and the powder is then dusted on them. W. D. Scouller & H. H. Goldthorpe use 20 gals. creosote (18 per cent. tar acid), emulsified with 14 lb. grease and 20 gals. of a 1 per cent. solution of sodium carbonate added to the filter influent at 1 gal. creosote to 175 sq. yards. The filter is rested for one hour before and after treatment. The dosing starts after the spring slough and is continued for about 20 days, and resumed for a few days after operation for ten days. It is stopped by September to allow the fly population to build up again for winter scouring. A certain amount of annoyance from flies is probably inseparable from the low rate filter. As regards the high rate filters, it is concluded that the high rate of application does not prevent breeding by *Psychoda*, but the heavy dosing may prevent its escape from the filter.

In the activated sludge system, in which, unlike the filter system, the amount of solids present is under the control of the operator, no benefit is to be derived from the presence of insect larvae and worms, and invasion by Chironomids on a large scale, as has been reported in the United States and India, is definitely harmful. According to R. B. Jackson, Chironomid larvae can destroy all the activated sludge in the system, so that the whole system breaks down and a fresh lot of sludge must be built up. He has found that pyrethrum powder (0·7–0·9 per cent. pyrethrins) at 1 lb. per 5,000 U.S. gals. tank capacity kills the larvae in a few hours, and 1 lb. to 20,000 U.S. gals. appears a safe dose to use.

[Pavlovskiĭ (E. N.).] **Павловский (Е. Н.).** Ed. **Conference on Parasitological Problems, December 1939 (Moscow-Leningrad). Summaries of Reports. Second Conference . . . November 1940 (Leningrad). Third Conference . . . March 1941 (Moscow).** [*In Russian.*]—56, 46, 68 pp. Moscow, Izd.Akad.Nauk SSSR, 1939, 1940, 1941.

These three publications comprise summaries of papers read at three successive conferences. Many of them, particularly those of the first conference, contain information that has already been noticed in this *Review*. Of those abstracted below, the first two were read at the first conference, the 17 following at the second, and the remainder at the third.

[Beklemishev (V. N.).] **Беклемишев (В. Н.). The Problem of Typifying Malaria Foci and a Survey of certain Types of Malaria Country in the USSR** (pp. 7–12). In order to work out a comprehensive plan for the control of malaria in the Russian Union, it is desirable to classify the types of foci of the disease and the control measures that are applicable to each [*cf. R.A.E.*, B **31** 220]. The Union can be divided into three zones from the point of view of malaria, namely, the northern region, which is free from the disease, since the summers are too cold for the survival of Anophelines, the northern half of the forest belt, where Anophelines persist and malaria appears in epidemic form

in warm years and disappears completely after a series of cold ones, and the southern region, comprising the rest of the Union, where climate favours the occurrence of foci of endemic malaria of various degrees of intensity. As examples of the classification of foci, the author describes the topography of three systems of plains of differing geological age, and outlines in each case the various types of water, their suitability for Anopheline breeding and the sort of control measures that could be applied. An area can also be classified as uncultivated, in which the distribution of Anophelines and the incidence of malaria are limited, partly cultivated, in which malaria is frequently rife owing to the creation of conditions that favour the breeding of mosquitos, or completely settled, in which conditions are so organised that outbreaks can easily be controlled.

[Pospelova-Shtrom (M. V.).] **Поспелова-Штром (М. В.). Tick Relapsing Fever and its Vector in Daghestan** (p. 52). In the course of investigations in Daghestan (north-eastern Caucasus) in 1939, ticks of the genus *Ornithodoros*, resembling *O. verrucosus*, Olen., Zas. & Fen. [*cf.* **26** 8], were found in numbers in the foot-hills and in the lower mountain belt at altitudes of up to 3,600 ft. in burrows of animals, chiefly foxes and small rodents. It is probable that many of them are naturally infected with relapsing-fever spirochaetes, since two of the three workers who were bitten by them contracted relapsing fever.

[Moskvin (I. A.).] **Москвин (И. А.). Spontaneous Infection of Birds with the Virus of the Tick-borne (Spring-Summer) Encephalitis** (pp. 12–13). Since various birds could be infected with the virus of tick-borne encephalitis by intracerebral inoculation [*cf.* **31** 70], the brains of 160 birds of 27 species taken in 1940 in a forest reserve in the south of the Province of Ussuri were investigated. The virus was isolated from birds of five species. Almost all the birds examined harboured larvae and nymphs of *Haemaphysalis japonica*, Nutt. & Warb., *H. concinna*, Koch, and *Ixodes persulcatus*, Schulze, and the virus was isolated from nymphs of *I. persulcatus* taken on one of them.

[Blagoveshchenskiĭ (D. I.).] **Благовещенский (Д. И.). Ticks of the Family Ixodidae and the blood-sucking Diptera of the Lower Amur** (pp. 15–17). Collections of ticks in July–August 1939 in an area along the lower Amur showed that *Haemaphysalis concinna*, Koch, *Dermacentor silvarum*, Olen., and *Ixodes persulcatus*, Schulze, were common, though they were not found in water meadows, a willow plantation or an aspen forest with an undergrowth of fern, and *I. persulcatus* was the only tick present in forests on the foot-hills. Adults of these ticks were taken on domestic animals and large wild mammals, and larvae and nymphs on various rodents, shrews (*Sorex* sp.), and 23 out of 51 species of birds examined. In the course of laboratory observations, some of the nymphs of *I. persulcatus* were found to be parasitised by *Hunterellus hookeri*, How. [*cf.* **32** 214], this being the first record of the parasite from this host or from the Russian Far East. Of the blood-sucking Diptera, mosquitos and Ceratopogonids were the most active at night, and Simuliids by day, especially in hot, cloudy, windless weather, *Simulium maculatum* subsp. *ussurianum*, Rubtzov, being the most abundant.

[Serdyukova (G. V.) & Khodakovskiĭ (A. I.).] **Сердюкова (Г. В.) и Ходаковский (А. И.). Ixodid Ticks in the western Sayan Mountains** (p. 17). The Ixodid ticks found in June–August 1940 on the northern slopes of the western Sayan Mountains in the south of the Province of Krasnoyarsk (central Siberia) were *Haemaphysalis concinna*, Koch, *Ixodes persulcatus*, Schulze, and an unidentified species of *Ixodes*, of which larvae, nymphs and a single female were taken on small mammals. *I. persulcatus*, the life-cycle of which appeared to require three years [*cf.* **32** 70], was abundant in mixed forest at an altitude of 1,300–1,500 ft., scarce in the coniferous forest at altitudes of 2,300–2,600 ft., and practically absent at altitudes of over 4,600 ft. There are no definite records of spring-summer encephalitis from the region, but cases of a disease

of the meningitis type have occurred in spring-summer in persons who had stayed in the forest. *Dermacentor nuttalli*, Olen., was the prevalent tick in the Abakan steppe, where a survey was carried out early in September. One of the inhabitants had recently recovered from a disease that was apparently a seasonal encephalitis.

[Pis'yaukova (V. V.).] **Письяукова (В. В.). The Types of Vegetation of Northern Sayans within the Limits of the southern Part of the Ermak Region, Province of Krasnoyarsk** (pp. 18–19). In the course of investigations in 1940 in the south of the district of Minusinsk (central Siberia) on the vectors of tick-borne encephalitis, a botanical survey was made in successive zones in the Sayan Mountains at altitudes ranging from about 1,300 to 6,600 ft. The topography of the zones and the types of vegetation in them are described. *Ixodes persulcatus*, Schulze, was abundant in mixed forests of pine, aspen and birch with a varied undergrowth, dense grass cover and a humid, well aerated soil [*cf.* **31** 70], at altitudes of up to 1,500 ft. and occurred in smaller numbers in the coniferous forest with an undergrowth of deciduous trees and bushes at altitudes of up to about 3,000 ft., but was not found in forests at higher altitudes or in bare stony areas.

[Khodakovskiĭ (A. I.).] **Ходаковский (А. И.). Certain Peculiarities in the patchy Distribution of the Ticks *Ixodes persulcatus* P. Sch. in the Taĭga Belt of the European Part of the USSR** (pp. 20–21). In the region of the Beloe-Ozero (White Lake) in the east of the Province of Leningrad, *Ixodes persulcatus*, Schulze, occurred in mixed stands of coniferous and deciduous trees that had supplanted the primeval forest. The adults were abundant on cattle at the end of May and the beginning of June and disappeared at the end of July. The females oviposited eight days after dropping from their hosts, and the eggs hatched in 43 days in nature. In the laboratory, the larvae and nymphs completed their development in 40 and 45 days, respectively, after feeding, but engorged larvae entered a diapause in the second half of August, at a temperature of 18°C. [64·4°F.] which lasted until the end of the following January. Larvae and nymphs were found on small mammals, chiefly in spring and the first half of summer. The ticks were most numerous in partly cleared parts of the forest, considerably less so in the more cultivated parts, and absent from the undisturbed primeval forest. Pasture rotation is recommended for control.

[Alfeev (N. I.).] **Алфеев (Н. И.). The Utilisation of *Hunterellus hookeri* How. for the Control of the Ticks *Ixodes ricinus* L. and *Ixodes persulcatus* P.Sch. with Reference to Peculiarities of their Metamorphosis under the Conditions of the Province of Leningrad** (pp. 23–25). Experiments in 1938–40 in the Province of Leningrad showed that *Hunterellus hookeri*, How., examples of which had been received from Montana, developed in nymphs of *Ixodes ricinus*, L., *I. persulcatus*, Schulze, and *Dermacentor pictus*, Hermann. The life-cycle was completed in minima of 37 days in the laboratory and 51–55 days under natural conditions. Adults emerged in August–September from nymphs that had been parasitised in the first half of the same summer or in the second half of the preceding summer. They were not very active in the laboratory, but flew readily in the field and attacked the larvae and nymphs of the ticks on their hosts, particularly those on hedgehogs. When about 200 parasitised nymphs of *I. ricinus* that had dropped from their hosts were released in a plot measuring 120 sq. yds. and ten hedgehogs were introduced at various times for three days and nights, all were subsequently found to bear parasitised nymphs and the parasite later emerged from 37 of the 294 nymphs collected from them.

An attempt was therefore made in 1938 to establish the parasite in a pasture covering an area of about 250 acres, which contained a large population of *I. ricinus* and smaller numbers of *I. persulcatus*. Nearly 2,600 adults of both sexes of *H. hookeri* were liberated, together with nearly 38,000 parasitised larvae and nymphs of *I. ricinus*, but no parasites were recovered from about 8,000

larvae and nymphs of this tick collected from 40 hedgehogs taken in the pasture in the autumns of 1938 and 1939. No parasites emerged in 1940 from hosts kept outdoors overwinter or from spring onwards, probably owing to the extremely cold winter and summer.

Adults of *H. hookeri* bred from nymphs of *D. pictus* in the laboratory were much larger, more active and more numerous than those from *I. ricinus*, and since the two ticks occur together further south, where the climate is warmer and wild hosts more numerous, it is suggested that an attempt should be made to establish the parasite in the Province of Orel.

[Olsuf'ev (N. G.).] **Олсуфьев (Н. Г.). On the Origin of the Foci of the Tick *Dermacentor pictus* Herm. in the southern Part of the Province of Moscow** (pp. 26–28). Observations in the south of the Province of Moscow showed that *Dermacentor pictus*, Hermann, which is a vector of piroplasmosis of horses and tularaemia, was numerous on watershed plateaux largely consisting of meadows and small deciduous woods and scarce in coniferous forests adjoining rivers and in cultivated land far from meadows and woods. Repeated collections of ticks made by means of muslin drags showed that their preferred habitats were moderately damp meadows. The adults occurred chiefly on sheep and cattle and in small numbers on dogs. Horses were practically free from infestation since they are kept in stables during the spring sowing period. The ticks were active from April, when the snows melt, until the beginning of June, when hot weather sets in, and attacked the animals as soon as they were driven to the pastures. The larvae and nymphs fed exclusively on small mammals, chiefly *Microtus arvalis*, *Arvicola amphibius* and *Sorex araneus*, and no ticks were found on animals living in forests.

Development from egg to adult lasted 2–3 months. Oviposition took place in the second half of May and in June, the larvae occurred from the end of June to the beginning of August and the nymphs were abundant in the second half of July and transformed into adults in August and September. Hot and dry weather favoured the development of the immature stages ; they were killed by prolonged cooling and were unable to overwinter. The young adults were inactive ; they sheltered and subsequently hibernated in the upper layers of the soil. Evidence has been obtained that most of the adult ticks hibernate twice before feeding, so that the life-cycle lasts two years. Some individuals, however, may need to feed earlier, which explains the occurrence of ticks, chiefly males, on cattle in September.

The wide fluctuations in the abundance of adult ticks in different years are related to the variations in numbers of small mammals, chiefly *Microtus arvalis*, but the two-year life-cycle ensures the survival of the ticks in years when Murids are rare. It is concluded that the abundance of the ticks is due to the systematic grazing of cattle in early spring in meadows that are densely populated by small mammals in summer.

[Rastegaeva (E. F.).] **Растегаева (Е. Ф.). Experimental Observations on Tick Paralysis of Sheep** (pp. 29–30). In experiments in Leningrad, in which larvae of *Ornithodoros lahorensis*, Neum., were placed on sheep and allowed to develop to the third nymphal stage, in which they usually drop from their hosts after feeding [*cf.* **25** 122], the animals showed paralysis after 21–23 days, when the ticks had just reached the third nymphal stage, provided that the latter were numerous [*cf.* **25** 3], but were only slightly affected by successive single individuals and not at all by only one tick. In similar tests with third-stage nymphs and adults, paralysis was caused in 9 days by mass feeding, but did not result from feeding by single individuals. Sheep that were still able to swallow sometimes recovered when the ticks were removed. Feeding by third-stage nymphs and adults caused paralysis in dogs in 23 days, but injection into healthy dogs of blood and a suspension of organs from dogs showing paralysis had no effect within a similar period. Paralysis is therefore believed to be due to a toxin injected by the ticks in the process of feeding and not to

an infectious agent, the effects depending on the amount of toxin injected and the degree of proximity of the ticks to the head and the spinal cord. Paralysis and death apparently result from disturbance of brain functions.

[Radzivilovskaya (Z. A.).] **Радзивиловская (З. А.). Data on the Ecology of the Larvae of Midges (Simuliidae) of the Mountain Rivers in the South-Ussuri Taïga** (pp. 33–34). Observations on Simuliids in a mountain stream in the south of the Province of Ussuri in 1940 showed that the temperature of the water was the most important ecological factor regulating the appearance of successive species throughout the season, while the rapidity of the current was not of primary importance. The minimum and maximum temperatures and rates of flow at which larvae occurred were 18·2 and 37°C. [64·76 and 98·6°F.] and about 8 ins. and 5–7 ft. per second. Under normal conditions the numbers of larvae and species were much smaller in the upper part of the stream than in the other parts. A rise in temperature and protracted drought, which caused the stream to become shallow or dry up, led to mass migrations of the larvae from the upper to the lower parts, whence they were carried by the current to the mouth. During such migrations, the numbers of larvae in the upper layers of water became equal to or greater than those in the lower layers, where they are normally more numerous. The larvae usually migrated during the day and rested during the night. They attached themselves to submerged stones, branches or twigs, and did not occur in places subject to the action of waves. In experiments on phototropism in which larvae were placed in a covered petri dish with an opening in the lid, almost all concentrated in a few seconds near the illuminated spot. The installation of sluices in mountain streams causes conditions unfavourable for the larvae, such as periodic fluctuations in water level, muddiness and constant changes in light and the rapidity of the current.

[Anisimov (I. I.), Kryukova (A. P.) & Latuishev (N. I.).] **Анисимов (И. И.), Крюкова(А. П.) и Латышев (Н. И.). On the natural focal Occurrence of Papataci Fever** (p. 34). The only true focus of sandfly fever in Turkmenistan was found in a small settlement near the town of Ashkhabad. The epidemic season lasts from May to the end of October, and the sandflies taken were *Phlebotomus papatasii*, Scop., and *P. minutus*, Rond. Burrows of mice, hamsters and the gerbilles, *Rhombomys opimus* and *Meriones erythrourus*, occurred round the settlement.

[Zmeev (G. Ya.).] **Змеев (Г. Я.). The Importance of the large Hornet (*Vespa orientalis*) in the Epidemiology of Dysentery** (pp. 34–35). Adults of *Vespa orientalis*, F., have been found in southern Tadzhikistan, naturally infected with dysentery bacteria. Experiments showed that they acquire these and other components of the intestinal microflora of man chiefly from the flies on which they prey. Examination of the microflora of their digestive tract showed that it was of faecal origin.

[Zmeev (G. Ya.).] **Змеев (Г. Я.). Certain Points in the Epidemiology of Dysentery and its endemic Foci in Central Asia connected with the Cockroach *Shelfordella tartara* Sauss.** (p. 35). Observations in Tadzhikistan showed that *Shelfordella tartara*, Sauss., which occurs in houses of the local type, ingests dysentery bacteria. These remain viable in the stomach, so that this Blattid may play some part in maintaining domestic foci of the disease in man.

[Zimin (L. S.).] **Зимин (Л. С.). A Survey of the synanthropic Diptera of Tadzhikistan** (pp. 35–38). Surveys of the Diptera that are associated with man in central and southern Tadzhikistan were carried out in 1939 and 1940, collections being made at intervals of three hours in houses, hospitals, restaurants, markets, abattoirs and animal quarters [*cf.* **31** 26]. In all, 120 species in 23 families were taken. On the whole, the fly fauna was more varied in the central region than in the south, and in older settlements than in more recent ones. From the point of view of seasonal occurrence, the flies are divided into four groups. The species of the first group, such as *Fannia scalaria*, F.,

appear in spring, are common in the early summer and autumn but scarce during the hottest period, frequent shady places and are active in the morning and late afternoon. Those of the second group, of which *Musca domestica vicina*, Macq., is typical, are most abundant and active in July and August and frequent a variety of habitats, but avoid excessive shade and bright sunlight. Those of the third, such as *M. sorbens*, Wied., and *Chrysomyia albiceps*, Wied., appear at the end of June and become abundant in August and the first half of September; they occur in the sun in open markets and streets and are most active during the hottest part of the day. The fourth group comprises species that appear in spring but do not become abundant until autumn, such as *Muscina stabulans*, Fall., and *Calliphora erythrocephala*, Mg., they have a limited range of habitats, prefer weak light and are most active late in the day. Flies were most abundant in houses in July and August, owing to the mass breeding of *Musca domestica vicina*. They were attracted to them by favourable conditions of light and temperature, as well as by the presence of food. The lowest temperature at which *M. sorbens*, *Chrysomyia albiceps*, *Sarcophaga* spp. and other southern species entered houses was 24–27°C. [75·2–80·6°F.] at a relative humidity of 32–35 per cent., whereas the corresponding figure for the cosmopolitan species and those that also occur in the far north was 8–16°C. [46·4–60·8°F.] at 47–58 per cent. A list of the flies found in buildings of various types is appended.

[Zimin (L. S.).] **Зимин (Л. С.). An Experiment in the Control of Flies under the Conditions of southern Tadzhikistan** (pp. 38–39). A campaign for the control of flies carried out in the summer of 1940 in four villages in southern Tadzhikistan reduced their numbers by 76–96 per cent. The chief measures adopted were the destruction or treatment with larvicides of manure, faeces and other breeding places; in view of the rapid development of flies, the treatments should be carried out at intervals of 3–5 days.

[Breevui (Z. F. & K. A.).] **Бреевы (З. Ф. и К. А.). Data on the Biology of the Reindeer Warble-fly** (*Oedemagena tarandi*) (pp. 40–42). Every one of a herd of 700 reindeer in the Timan tundra (north of European Russia) was found to be infested by larvae of *Hypoderma* (*Oedemagena*) *tarandi*, L. The average number of warbles per animal decreased as its age increased in the case of females, but increased in the males up to the age of 5–6 years, reaching a maximum of 135·7. Healthy, well nourished animals usually had fewer warbles than sick and emaciated ones. The warbles were most numerous on the rump, and became progressively fewer along the spine, on the shoulder-blades and on the neck; none occurred on the head. Most of the larvae abandoned the warbles in May and June. The most favourable conditions for pupation and the survival of the pupae occurred in dry areas on peat moors, whereas few larvae and pupae survived if the ground was stony, sandy or hard and had little or no vegetation, as most of them were killed by birds and other predators or by the high day temperatures of the soil, which sometimes exceeded 40°C. [104°F.] The pupae did not survive repeated prolonged flooding, and their development was retarded by ten days or more in shaded or damp areas. Male and female adults were about equally numerous and survived for up to a month, death occurring earlier in hot or prolonged wet weather. They were not killed by night temperatures of −5°C. [23°F.]. Adults were present from June to September, and mass flights occurred on sunny days at temperatures of 19–20°C. [66·2–68°F.] or above. The females laid 600–700 eggs each, depositing them in batches on various parts of the body of the reindeer, chiefly on the flanks, hips and hind legs. The larvae hatched in 4–5 days and burrowed into the skin, but they did not attempt to do so when placed on man. Having penetrated the skin, they migrated towards the rump and spine, sometimes penetrating deep between the muscles, and warbles appeared 80–90 days later, the first ones being observed in late September or early October. The females are attracted by the odour of reindeer urine, which may explain the concentration of oviposition on hind parts of the animals

[Pavlovskiĭ (E. N.) & Alfeeva (S. P.).] **Павловский (Е. Н.) и Алфеева (С. П.). Local Reactions in the Skin of Reindeer caused by Larvae of the Warble-fly** (*Oedemagena tarandi*) (pp. 42–43). Descriptions are given of the changes that take place in the skin tissues of reindeer owing to the presence of warbles caused by larvae of *Hypoderma* (*Oedemagena*) *tarandi*, L. Scars, knots and bald patches formed on the sites of the warbles, particularly in the case of those containing larval exuviae, lower the quality of the hides and may render them unsaleable.

[Lokk (A. P.).] **Локк (А. П.). The pharmacological Characteristics of Extracts of the Larvae of Reindeer Warble-flies** (pp. 43–44). Extracts of dried larvae of reindeer warble-flies [*Hypoderma tarandi*, L.] diluted to a concentration of 10 per cent. and applied to the eye of a rabbit had only a slightly irritating effect ; dilutions of 5–20 per cent. injected subcutaneously or intramuscularly into rabbits caused local swellings and sometimes suppuration, but the general effect of the extracts on rabbits and mice was not particularly toxic. When introduced intravenously into cats, the extracts caused a drop in blood pressure and increased respiration. Injection into blood increased coagulation.

[Markov (A. A.).] **Марков (А. А.). The Importance of Ixodid Ticks in the Preservation of Haemosporidia** (pp. 7–9). Of the Haemosporidia that cause various forms of piroplasmosis in domestic animals in the Russian Union, *Theileria annulata*, which infects cattle, differs from those that infect horses and sheep in that it does not persist in successive generations of its tick vectors. It can be controlled by the substitution of non-susceptible for susceptible animals on pastures known to contain infected ticks, and it has been thought that this measure would also prevent the hereditary transmission of the organisms that do persist. In experiments begun in 1936, however, Dzasokhov & Tzaprun found that *Piroplasma caballi* persisted in *Dermacentor marginatus*, Sulz., through three generations reared on immune hosts, and Markov & Kurchatov obtained seven generations of *Rhipicephalus bursa*, C. & F., examples of all of which transmitted *Piroplasma* (*Babesiella*) *ovis* to sheep, though the active stages in each were fed on immune animals [*cf.* **29** 75]. The virulence of the infection increased with the fourth generation of ticks and then remained at a level that caused sheep to die 2–3 days after the ticks became attached.

[Olsuf'ev (N. G.).] **Олсуфьев (Н. Г.). New Data in the Study of the Ecology and pathogenic Importance of the Tick** *Dermacentor pictus* **Herm.** (pp. 10–11). Much of the information here given on the bionomics and ecology of *Dermacentor pictus*, Hermann, in the south of the Province of Moscow is similar to that already noticed [*cf.* **34** 109]. The principal host of the larvae and nymphs is *Microtus arvalis*, which is common in meadows, and in July, when these stages are most numerous, 60 per cent. of the examples of this vole taken in meadows were infested. The numbers of larvae and nymphs per infested animal averaged 18–25 and 5–10 and ranged up to 282 and 51, respectively. In experiments, feeding by 31 adult females was fatal to a guineapig and feeding by 40–50 or more nymphs to small rodents, including *M. arvalis*.

Observations in a focus of tularaemia suggested that *D. pictus* may play some part in the dissemination of this disease among rodents. In the laboratory, the bacteria persisted in the ticks from stage to stage and some evidence was obtained that they also persist from one generation to the next. Infected nymphs transmitted the infection fairly easily to guineapigs and examples of *Microtus*, and adults to guineapigs and rabbits on which they engorged, and white mice and *Microtus* acquired it by eating infected ticks. Since the adults remain inactive for long periods [*cf. loc. cit.*], they may serve as perennial reservoirs of infection, and the fact that naturally infected ticks have repeatedly been found in years following those in which Murids were abundant, and epizootics of tularaemia occurred among them, supports this view.

[Zhmaeva (Z. M.).] **Жмаева (З. М.). The Ticks *Haemaphysalis concinna* Koch, as Vectors of Tick-borne Spotted Typhus in the Far East** (p. 14). The ticks found in a focus of tick-borne disease of the spotted-fever type [*cf.* **27** 240] in the Maritime Province of the Russian Far East in 1939–40 were *Dermacentor silvarum*, Olen., *Ixodes persulcatus*, Schulze, *Haemaphysalis japonica douglasi*, Nutt. & Warb., and *H. concinna*, Koch. Cases of the disease occurred from May until August, and the commonest tick during this period was *H. concinna*. Its characteristic habitats were damp areas such as drying hillocky marshes covered with grassy vegetation and shrubs. The adults infest cattle, horses and dogs from early spring until August, and the larvae and nymphs occur on small rodents. A strain of spotted fever was isolated from adults taken on dogs in July near Vladivostok and was maintained in guineapigs in the laboratory. It caused a rise in temperature and was accompanied by scrotal reaction; rickettsiae were present in smears from the tunica vaginalis.

[Folitarek (S. S.).] **Фолитарек (С. С.). The Persistence and Methods of Elimination of Foci of Spring-Summer Encephalitis on the Volga and in the Region of the Ural Mountains** (pp. 15–16). Investigations in 1940 on the middle Volga (Province of Kuĭbuishev) and the adjoining parts of the Province of Chkalov and the Tartar Republic showed that natural foci of spring-summer encephalitis were associated with plateaux and watersheds, where ravines were numerous and lime trees were abundant in the forests in them. They were characterised by high rainfall, the boundaries of the infected areas, and even of individual localities in which cases had occurred, being clearly defined by the 12-in. summer isohyet. In the area along the Ural mountains (former Province of Perm and the adjoining regions), the disease was also associated with high precipitation and mixed forests of spruce and lime trees. In both the areas surveyed, the forests in ravines provided favourable conditions for the vector, *Ixodes persulcatus*, Schulze. This was the only type of habitat in which naturally infected examples of the tick and of the rodent, *Apodemus flavicollis*, were found, and since small rodents often survive in these forests when they are scarce elsewhere, the preservation of the virus is assured. There was a high natural mortality among many birds and animals, and particularly small rodents, in forests near the Urals in the winter of 1938–39, and the number of cases of encephalitis in the area in 1940 was only about one-tenth of that in 1939, probably owing to a decrease in the number of ticks. Foci of the disease can be eliminated by measures that render conditions unsuitable for the wild hosts of the ticks, so that the circulation of the virus in nature is interrupted. Such measures are forest sanitation, cutting down over-mature stands, clearing shrubs and thinning stands of young lime trees; grazing in forests should be prohibited, and shooting of squirrels, hares and game-birds encouraged.

[Kozlova (A. V.) & Grachev (P. E.).] **Козлова (А. В.) и Грачев (П. Е.). Rodents, Insectivora and Birds in the Suputinka Reserve (Far East) as Hosts of Tick Vectors of Tick-borne Encephalitis** (pp. 17–19). During work in 1940 on spring-summer encephalitis in the south of the Province of Ussuri (Russian Far East) [*cf.* **34** 68, 70], collections of small mammals and birds likely to serve as hosts for the larvae and nymphs of the tick vectors were made between 26th June and 28th July in a forest reserve in which natural foci of the disease occur. Lists are given of the ten species of rodents and Insectivora and the 18 species of birds taken. Of the ticks found, *Ixodes persulcatus*, Schulze, *Haemaphysalis japonica*, Nutt. & Warb., *H. concinna*, Koch, and *Dermacentor silvarum*, Olen., represented 49·7, 36·6, 10·7 and 3 per cent., respectively. The mammalian hosts most commonly infested were squirrels (*Sciurus*), chipmunks (*Eutamias*) and hedgehogs (*Erinaceus*), but Murids are also important since their great abundance compensates for a lower rate of infestation. Birds harboured ticks of the first three species only, and four species were commonly infested [*cf.* **34** 107].

[Naĭdenova (G. A.).] **Найденова (Г. А.). On the Ticks of the Family Ixodidae in White Russia** (pp. 20–21). During investigations on spring-summer encephalitis in the Republic of White Russia in 1940, 12,000 ticks were collected at 16 points between 20th May and the end of July. They comprised larvae, nymphs and adults of *Ixodes ricinus*, L., which was by far the commonest, and adults of *Dermacentor pictus*, Hermann, which occurred on cattle and were not found after 1st June. The larvae of *I. ricinus* were taken on small rodents and on birds, the nymphs on birds, and adults on man, cattle, horses, hedgehogs, dogs and a cat. The distribution of the tick in nature was patchy; it occurred chiefly in marshy forests among dense growths of ferns and sedges alternating with young spruces. It was less common in pine forests and was restricted to spots covered with low dense trailing vegetation. In the second half of July in the forest reserve of Belovezh [former Polish territory], the adults of *I. ricinus* were common in the clearings between the areas occupied by the European bison, which were overgrown with tall grass, ferns and young birches. The chief hosts of the nymphs and larvae were squirrels and small Murids, respectively. Strains of spring-summer encephalitis were isolated by Chumakov & Zeĭtlenok from examples of *I. ricinus* taken at five points in White Russia by feeding nymphs on white mice and by injection of suspensions of engorged and partly engorged adults.

[Markov (A. A.).] **Марков (А. А.). The Establishment of a new Vector of Piroplasmosis of Sheep (the Tick *Haemaphysalis otophila* Sch.)** (pp. 22–23). Following the occurrence of mortality among lambs infested by *Haemaphysalis otophila*, Schulze, and *Dermacentor silvarum*, Olen., the symptoms including acute anaemia and paralysis, on farms in the region of Ordzhonikidze (Caucasus) in the autumn and winter of 1940, ticks from the sheep were collected for examination. When adults of *H. otophila* were placed on a ewe, *Piroplasma ovis* appeared in its blood 8 days later. *H. otophila* occurs in various parts of the Caucasus, the Crimea and western Turkmenistan, and the conclusion that it is a vector of *P. ovis* is supported by the fact that outbreaks of the disease have been observed in the autumn-winter season when the sheep are often infested by it, but are free from adults of *Rhipicephalus bursa*, C. & F., the usual vector. In experiments with *D. silvarum*, the ticks did not become attached to their hosts, but a suspension of ten females produced symptoms of acute anaemia and weakness when injected subcutaneously into a ram, and *Anaplasma ovis* appeared in its blood after 20 days.

[Korneev (P. V.).] **Корнеев (П. В.). A new Vector of Piroplasmosis of Cattle (*Piroplasma bigeminum*) in the Province of Voronezh** (p. 24). Though *Boophilus calcaratus*, Bir., which is the known vector in the Russian Union of piroplasmosis of cattle caused by *Piroplasma bigeminum*, has not been found in the Province of Voronezh [*cf.* **25** 241], the disease has occurred there with increasing frequency since 1934, affected animals being found infested by *Haemaphysalis cinnabarina punctata*, C. & F. In experiments with this tick, cattle were infected by females that were the offspring of adults from infected animals and had been fed as larvae and nymphs on rabbits.

[Petrov (V. G.).] **Петров (В. Г.). The Development of the Piroplasm *Babesiella bovis* in the Tick *Ixodes ricinus* L. and the Method of Examining Ticks for its Presence** (pp. 29–31). In view of the divergence of opinion as to whether piroplasms multiply in their tick hosts by sexual reproduction or by fission, the development of *Piroplasma* (*Babesiella*) *bovis* in *Ixodes ricinus*, L., was investigated in Leningrad by means of histological sections and preparations of the internal organs. The various forms of the parasite that were observed in infected females and their progeny are described. It is concluded that when the ticks have engorged on infected cattle, the gametes of the parasite mature in the blood in the gut and pair to form zygotes. Most of the latter penetrate the wall of the gut and enter the ovary and the eggs, though some are occasionally retained by the wall of the gut and rapidly transform into sporoblasts, which

produce sporozoites. In the egg, some of the parasites become round, increase in size and also produce sporozoites, but others remain as mobile zygotes. These enter the internal organs of the larvae, including the salivary glands, in the course of embryonic development, and are also found in those of the nymphs and adults. In the salivary glands, the parasites become round, increase in size and transform into sporoblasts, some of which produce sporozoites while the tick is in the larval stage and some when it is in the nymphal or adult stage [*cf.* **20** 82, 137].

The salivary glands are much more easily examined for the presence of sporozoites by preparation and staining of the whole organs than by histological sections, and, in a test of the validity of the method as a source of information on the prevalence of infected ticks in pastures, 91 (25·6 per cent.) of 355 ticks collected in two pastures in which 10–40 per cent. of the cattle contracted piroplasmosis every year were shown to be infected, as compared with only one (1·3 per cent.) of 77 from a healthier pasture and none of 180 from a pasture in which no cattle had become infected. It is concluded that a reliable estimate can be obtained from the examination of 100 ticks per pasture.

[Svirskaya (S. A.).] **Свирская (С. А.). On the Ticks of Mongolia** (pp. 32–33). During a survey carried out over a large area in the Mongolian People's Republic in 1936–40, over 7,000 domestic animals and over 700 wild mammals, birds and reptiles were examined for ticks. Those found belonged to the genera *Dermacentor*, *Hyalomma* and *Ixodes*, of which the first two predominated, the adults occurring on man and a great variety of domestic animals and wild mammals, which are enumerated. The adults of *D. nuttalli*, Olen., were most abundant in spring and autumn and were absent from late July to late September. They infested animals in autumn, but only the males fed at that time, both in nature and in the laboratory. Some of the adults overwintered on cattle, but the majority did so in pastures. Larvae and nymphs occurred from June until late autumn on rodents, wild cats and dogs; in the laboratory, they attached themselves to rodents, lizards and a horse, but not to snakes or man. The offspring of engorged females taken on animals in May reached the adult stage in August. Adult females survived starvation under natural conditions for 22 months, but the males were considerably less resistant. Unfed adults of *H. dromedarii*, Koch, were taken on cattle late in autumn in the western part of the area, but this tick was not found in spring or summer. *Ixodes* sp. occurred only on rodents, birds and wild cats, the larvae and nymphs in autumn and the adults in autumn and winter; engorged females were taken at temperatures ranging from −14 to −40°C. [6·8 to −40°F.] and oviposited when kept in the laboratory at 18°C. [64·4°F.]. Pasture ticks are serious pests of stock in Mongolia, and *D. nuttalli* is a vector of piroplasmosis of horses.

[Tzelishcheva (L. M.).] **Целищева (Л. М.). The Fauna of Ticks of the Superfamily Ixodoidea and their epizootological Importance in Kazakstan** (pp. 34–36). Observations begun in 1935 have shown that there are 28 species of Ixodids and six Argasids in Kazakstan, their distribution depending on climate, type of soil and vegetation. *Boophilus calcaratus*, Bir., which is a vector of piroplasmosis of cattle caused by *Piroplasma* spp., is common in the southern districts, but was not found in the south-east, where the disease is transmitted by *Haemaphysalis cinnabarina punctata*, C. & F. The form of bovine piroplasmosis caused by *Theileria* is less widely distributed in southern Kazakstan than are the species of *Hyalomma* that transmit it [**31** 105]. Equine piroplasmosis is common and is transmitted by ticks of five species. Owing to the absence of *Rhipicephalus bursa*, C. & F., no case of piroplasmosis of sheep has been observed, but *Ornithodoros lahorensis*, Neum., which causes tick paralysis in sheep, is common throughout the south and is responsible for wasting and mortality. *Argas persicus*, Oken, is widely distributed in the south, where many fowls die of spirochaetosis [caused by *Spirochaeta anserina*].

[Lototzkiĭ (B. V.).] **Лотоцкий (Б. В.). The Ixodid Ticks of Tadzhikistan** (pp. 37–38). The author states that 19 species of Ixodids have been found on mammals, birds and reptiles in Tadzhikistan since work was begun on them in 1932 and gives the names of some of them, without recording their specific hosts, together with notes on their seasonal occurrence and distribution at different altitudes.

[Olenev (N. O.).] **Оленев (Н. О.). The geographical Distribution and certain Features of the Ecology of the Ticks *Ixodes* under the Conditions of the North-West of the U.S.S.R.** (pp. 39–40). An outline is given of the distribution in the north-west of European Russia of *Ixodes ricinus*, L., and *I. persulcatus*, Schulze, and a common form of the latter is briefly characterised as var. *cornuatus*, n. Observations in forests in the east of the Province of Leningrad showed that *I. persulcatus* occurred in small numbers in natural pastures in damp woods of alders and willows. Cattle were infested from early May, when they were driven to pasture, until mid-July, when the ticks disappeared. The life-cycle of *I. persulcatus* was completed in 137–170 days in the laboratory at 20–30°C. [68–86°F.] and a relative humidity of 100 per cent. Unfed females survived for about a month and partly engorged ones for over 100 days. Both unfed and engorged females paired, but only those that weighed at least 90 mg. oviposited; females weighing 250 mg. laid about 3,000 eggs. The larvae hatched in 32–34 days and readily attached themselves to hedgehogs, on which they fed for 3–6 days. The larval and nymphal stages each lasted about 6 weeks. Adult females fed on cows for 4–12 days and oviposited 5–14 days afterwards. The duration of development of eggs kept in test-tubes at a relative humidity of 100 per cent. was inversely related to temperature within the limits of 5 and 30°C. [41 and 86°F.]. The eggs did not survive at a humidity of 65 per cent., but some hatching occurred, though it was delayed, when they were submerged in water [*cf.* **32** 71]. Engorged larvae moulted normally in test-tubes containing moistened filter paper, but not when submerged.

[Sudachenkov (V. V.).] **Судаченков (В. В.). The Causes of the patchy Distribution of the Infestation of Pastures by Ticks in the Province of Leningrad and their Importance in the Epizootology of Babesiellasis of Cattle** (pp. 41–44). Investigations in 1933 and 1936 on the frequency of *Ixodes ricinus*, L., and *I. persulcatus*, Schulze, in pastures showed that the average numbers of females of these ticks per head of cattle were 23·6 in the western and south-western districts (between the Gulf of Finland and Lakes Ladoga, Ilmen and Peipus) and 0·6–1·8 in the eastern and south-eastern districts; infestation was intermediate in intensity in the north-eastern districts adjoining Lakes Ladoga and Onega.

Factors that contribute to the lower infestation in the east as compared with the west are that cattle are driven to pasture 10–15 days later, so that maximum infestation is delayed, the season favourable for the development of ticks is 25–30 days shorter, hedgehogs are less than half as numerous, variations in day and night temperatures are much sharper, and relative humidity during the hot summer is low. During the grazing period the females oviposit, but not all the eggs hatch, and though most of the larvae that feed in May and June moult to the nymphal stage, only nymphs that engorge in early spring give rise to adults while the cattle are still present. Up to 85 per cent. of the engorged ticks die in dry years, and most of these are females. It is known that unfed larvae, nymphs and adults survive the winter best and that engorged females cannot overwinter. The eggs are the least resistant of the over-wintering stages, and all that survive are apparently destroyed in spring by predators. Engorged larvae and nymphs are more resistant, but are also destroyed in large numbers. Owing to the climatic conditions in the east of the Province, development of the individual stages is prolonged, so that eggs and engorged larvae and nymphs are present at the onset of winter. Since

I. persulcatus occurs throughout the area of these climatic conditions, it may be regarded as a race of *I. ricinus* adapted to the more stringent conditions of a continental climate, and its predominance in a given area as an indication that the locality is unfavourable for persistent infection of cattle with *Piroplasma*.

The causes of the uneven infestation of pastures within a district was studied in the western part of the Province. The absence of ticks from open pastures was due to the prolonged occurrence of relative humidities below 75 per cent., which is the lower limit for *I. ricinus*. Infestation was heaviest (80–134 ticks per head of cattle) in pastures that were covered with dense growths of low broad-leaved trees with a few conifers. Less infested pastures (14–30 ticks per head) contained the same species of trees but they were tall, and the least infested ones (1–10 ticks) were covered with pines and birches of varying height. The climatic conditions prevailing in this area are favourable for the maintenance of *Piroplasma* in cattle, and new foci are formed if fresh clearings in forests are used as pastures or if open grazing lands become overgrown with trees.

Within the pastures themselves, the numbers of ticks were negligible in marshy areas covered with moss or sedges, in plains sparsely covered with a mixture of low pines, birches and alders, in water meadows in which willows were growing and in mixed forests of tall trees, and were smaller on southern slopes than on northern ones less exposed to the direct rays of the sun.

[Orlov (E. I.).] **Орлов (Е. И.). Ecological Factors in the focal Occurrence of Ticks in the Region of the Lower Volga** (pp. 45–47). A study showed that the factors that lead to the formation of breeding centres of *Dermacentor silvarum*, Olen., in the forest-steppe zone on the Lower Volga are variable. The tick develops as well in dry open places as in damp forests, and the adults survive even in areas that are subject to temporary flooding, though excessive humidity generally kills them. Development is retarded and uneven in wooded areas but rapid and more uniform in open ones, so that larvae and nymphs become abundant more quickly in the latter. On the other hand, unfed ticks survive better in moderately damp forests, especially in years of drought. Variations in the abundance of small mammals that are hosts of the larvae and nymphs result in similar fluctuations in the tick population and the small mammals that live in forests are of importance in securing the survival of the tick in years in which conditions in open habitats are unfavourable. The formation of tick foci is favoured by allowing cattle to graze in or near forests, particularly in years of drought. Small breeding centres arise on the edges of forests in places where hamsters (*Cricetus cricetus*) occur, and the ticks also breed in depressions and ravines covered with shrubs and dense grassy vegetation. A general programme of control measures, largely concerned with the destruction of rodents, is outlined.

[Pavlovskiĭ (E. N.), Galuzo (I. G.) & Lototzkiĭ (B. V.).] **Павловский (Е. Н.), Галузо (И. Г.) и Лотоцкий (Б. В.). The System of Control Measures against Ticks transmitting Theileriasis and Piroplasmosis of Cattle in Tadzhikistan and its Foundations** (pp. 48–50). The vectors of piroplasmosis of cattle in Tadzhikistan are *Boophilus calcaratus*, Bir., which transmits species of *Piroplasma*, and *Hyalomma* spp., particularly *H. detritum*, Schulze, which transmit *Theileria*. These ticks are common in valleys, and the disease usually occurs in cultivated land under irrigation. *B. calcaratus* has three generations a year, of which the last two overlap, and there are thus three peaks in the infestation of cattle. *H. detritum* has only one generation a year; the larvae and nymphs occur on cattle in autumn and winter, and the adults in summer. Since the areas of distribution of these ticks overlap a single system of measures has been worked out for their control. It includes the treatment of cattle with chemicals to destroy the ticks on them, the use of agricultural measures to render the microclimate of pastures unfavourable to ticks, rotation of pastures, and cleanliness in the farm buildings.

[Galuzo (I. G.).] **Галузо (И. Г.). The ecological Characteristics of the main Representatives of the Tick Fauna of the Kazakh S.S.R. and the Basis of Control** (pp. 51–55). Of the Ixodids that infest farm animals in Kazakstan, *Boophilus calcaratus*, Bir., *Hyalomma detritum*, Schulze, and *H. savignyi*, Gerv., feed on them in all stages, but the larvae and nymphs of *Dermacentor marginatus*, Sulz., *D. silvarum*, Olen., *H. marginatum*, Koch, *H. dromedarii*, Koch (*asiaticum*, Schulze & Schlottke) and *Ixodes persulcatus*, Schulze, feed on other hosts. These ticks are transported by the animals on which they feed and come into contact with a variety of environmental conditions. The eggs of *H. detritum*, which produces one generation a year, are laid and hatch in shaded habitats, such as water meadows, pastures covered with shrubs and vegetation growing near water; the larvae aestivate on the surface of the soil and the nymphs overwinter on their hosts. *H. savignyi*, which has several generations a year, hibernates off its hosts and can overwinter and develop in animal quarters and even in houses. *B. calcaratus*, which also has several generations a year, overwinters in the egg and larval stages in meadow-steppes, waste lands overgrown with grasses and in old non-irrigated lucerne fields. In summer, it oviposits in low-lying marshy areas and water meadows and along the edges of irrigation ditches. *H. marginatum* oviposits in marshy places protected from light, such as thickets, water meadows and shaded gorges, and the nymphs overwinter in grass meadows. *D. silvarum* overwinters as an engorged nymph or an unfed adult in steppes and forest-steppes in places that are not subject to floods, and large numbers of the males overwinter on farm animals. Oviposition takes place in marshy places under heavy shade.

Control measures should be designed to alter the habitats of the ticks and interrupt their cycle of development. Those recommended include replacing natural pastures by cultivated ones [*cf.* **24** 299], draining marshes, maintaining irrigation ditches in good condition, and keeping animal quarters free of ticks. In the case of *H. detritum*, cattle should be disinfested in winter and shifted to fresh pastures in summer and autumn, so that the larvae and nymphs that have dropped from them will not find further hosts.

[Agrinskiĭ (N. I.).] **Агринский (Н. И.). Methods of controlling Ticks that transmit Nuttalliasis and Piroplasmosis of Horses in Central Asia** (pp. 56–57). Good control of Ixodid ticks that transmit equine piroplasmosis caused by *Piroplasma* [*caballi*] and *Nuttallia* was obtained in Central Asia by spraying parts of infested horses with a solution of sodium arsenite containing 0·2–0·24 per cent. arsenic trioxide and removing the ticks by hand. Treatment was repeated every six days during the season. Dipping the horses in an arsenical solution was effective, but was abandoned as it led to undue fatigue in the animals at work. Burning the previous year's grass in pastures infested by *Hyalomma marginatum*, Koch, gave good control.

[Chizh (A. N.).] **Чиж (А. Н.). An Experiment on the Control of Pasture Ticks by Treatment with Arsenite under the Conditions of the Province of Leningrad** (pp. 58–60). Work on the use of a solution of sodium arsenite against ticks on cattle was begun in the north-west of Russia in 1926. In laboratory tests by Alfeev, Chizh & Petrov, it acted on the larvae and nymphs of *Ixodes ricinus*, L., partly as a contact poison; mortality due to this effect averaged 85 per cent., and unfed ticks were less resistant than partly or fully engorged ones. On treated animals, the mortality of the ticks increased with a rise in concentration and decreased with the length of time that had elapsed since the treatment. Solutions containing 0·16 per cent. were effective for less than three days, and those containing 0·18 per cent. for up to four days; neither harmed the animals. B. D. Kustrya found that sodium arsenite applied externally to animals penetrates through the skin and is distributed throughout the body by the blood. Arsenic begins to accumulate in the tissues after a few treatments, and more is accumulated in animals treated with a 0·18 per cent. solution than in those treated with 0·16 per cent. Chizh also showed that treatment with

sodium arsenite protected cattle against infection with piroplasmosis. When larvae of *I. ricinus* infected with *Piroplasma* (*Babesiella*) *bovis* were placed on calves that had been treated three times, none of the latter became infected, whereas the control animals showed a rise in temperature and various forms of *P. bovis* were observed in the blood. In further experiments, larvae of *Boophilus calcaratus*, Bir., infected with *Piroplasma major* (*Françaiella colchica*) were placed on two calves treated with sodium arsenite; one calf remained healthy, but the other, on which the ticks had been placed on a shaved area that had been washed with water and alcohol, contracted the disease.

Sodium-arsenite solution was first used on cattle on a large scale in the Province of Leningrad in 1932. The animals were sprayed or washed with it, and the numbers treated rose until 1936 and then declined, partly owing to the difficulty of the treatment and its dangers. Up to 83 per cent. reduction in the incidence of piroplasmosis occurred on farms on which treatment was carried out against *I. ricinus* in 1936, as compared with 1935, but owing to the subsequent decline in the number of animals treated, the disease became as prevalent in later years as it was before. Special observations on one farm showed that treatment with 0·16 or 0·18 per cent. solutions reduced tick infestation by half, as compared with untreated animals. Control of *I. ricinus* is complicated by the fact that it is a three-host tick and that its life-cycle in this Province lasts up to three years, so that it is some time before a reduction in population due to treatment of cattle becomes apparent. Treatment is valuable, but since the animals become infested with *I. ricinus* in spring and piroplasmosis is commonest in June and July, it may be restricted to the two months beginning on 15th May.

[Tzelishchev (A. A.).] **Целищев (А. А.). The Application of Chemical Measures for the Control of Ixodid Ticks in Kazakstan** (pp. 63-64). Since piroplasmosis of cattle caused by *Theileria* is common in southern Kazakstan [*cf.* **31** 105], measures against its tick vectors are necessary. Treatment with sodium-arsenite solution is not by itself sufficient, since it gave only 65 per cent. reduction in the incidence of the disease in observations over two years, though this figure was raised to 91·7 per cent. in the first year and 97 in the second when treatment against ticks was also carried out in animal quarters and the cattle were transferred to mountain pastures. Winter treatment is also necessary, since cattle are then infested by *Hyalomma savignyi*, Gerv., *H. marginatum*, Koch, and *H. detritum*, Schulze, which transmit *Theileria*, and by *Boophilus calcaratus*, Bir., which transmits *Piroplasma*. As animals cannot safely be treated with liquids in cold weather, experiments were carried out with a dust treatment. The dust used was a by-product of the phenol industry known as desinsectalin, which has been employed against lice of the genus *Haematopinus*. It proved effective in the laboratory and under field conditions against various ticks. It acted as a fumigant, volatilised at 10°C. (50°F.), was harmless to the animals and did not affect the quantity or quality of the milk. In experiments by Rodionova at Alma-Ata, it was effective against *Psoroptes* [*ovis*, Hering] on sheep.

[Chumakov (M. P.).] **Чумаков (М. П.). Further Study of the Area of Distribution and Peculiarities of the Epidemiology of Tick-borne Encephalitis of Man in the European Part of the U.S.S.R.** (pp. 65-67). During 1940, 17 cases of tick-borne encephalitis were observed in White Russia (Provinces of Minsk, Moghilev, Vitebsk and Brest), 12 cases in the Karelian-Finnish Republic, single cases in the Bashkir and Tartar Republics and the Provinces of Archangel, Kirov, Leningrad and Yaroslav [*cf.* **29** 42], and four cases in the town of Alma-Ata (southern Kazakstan). Over 30,000 ticks were collected in various parts of European Russia and studied. Both *Ixodes persulcatus*, Schulze, the usual vector, and *I. ricinus*, L., occurred in Karelia, and strains of the virus were isolated from larvae, nymphs and engorged females of these ticks in Karelia, though the species was not ascertained, and one from ticks from former Finnish

territory. *I. persulcatus* did not occur in White Russia, but *I. ricinus* was abundant and naturally infected examples were taken in four regions. In experiments, the virus was preserved in this tick from stage to stage and from generation to generation and was transmitted to animals on which it fed. Strains of the virus were also isolated from nymphs of *I. ricinus* taken on rodents and from the brains of heavily infested voles [*Microtus*], all collected in the forest reserve of Belovezh. Natural foci of encephalitis therefore occur in the Russian Union not only in the Far East and in the region of the Urals, but also in the extreme west, including former Polish territory.

The blood of cows from three endemic regions of encephalitis in White Russia and of cows and horses from Karelia was found to contain protective antibodies. No virus was isolated from ticks that contained undigested blood of cows, and it is possible that the virus in ticks may be affected by antibodies in the blood of animals on which they feed. On the other hand, active virus has been isolated from the progeny of ticks that had fed on immune animals and a typical strain was isolated from a guineapig after ticks taken on a cow had fed on it.

No virus was obtained from ticks taken in Azerbaijan, Daghestan or the Province of Moscow, but a neurotropic filterable virus was isolated at least three times from examples of *I. ricinus* taken in the western Ukraine.

STRICKLAND (E. H.). **A Method for permanently reducing the Number of Blowflies in screened Houses.**—*Bull. Brooklyn ent. Soc.* **40** no. 2 pp. 59–60. Lancaster, Pa., 1945.

Towards sunset, particularly when the nights are inclined to be cool, blowflies have the habit of squeezing themselves into small crevices, such as those round the edges of doors and fly-screens and in badly fitted eaves, and many thus find their way into screened houses. As they are attracted to light, they eventually reach the windows during daylight, where the screens prevent their escape. When crawling on the screens, they always move upwards, and having reached the upper edge, they crawl along it horizontally. If a pencil is pushed through the screen at one of the top corners, all blowflies will sooner or later leave through the hole, provided that the window is partly open and the awning, if any, is raised. Since the flies, when in the open, are inactive at dusk, none will return through the hole when the rooms are lighted. If it is feared that mosquitos will enter through the hole, though the author has never observed them to do so, a cork can be used to close it during the season when they are active. Several houses have been kept practically free from blowflies for a number of years by this method, and it has also been used with excellent results to reduce a large population of blowflies in the buildings of a military camp.

GOOD (N. E.). **A List of the Mosquitoes of the District of Columbia.**—*Proc. ent. Soc. Wash.* **47** no. 6 pp. 168–179, 12 refs. Washington, D.C., 1945.

A list is given of the 37 species of mosquitos that have been recorded from the District of Columbia, with notes on their abundance and seasonal occurrence and the breeding places of most of them. The Anophelines included are *Anopheles barberi*, Coq., *A. crucians*, Wied., *A. punctipennis*, Say, *A. quadrimaculatus*, Say, and *A. walkeri*, Theo. *Aëdes aegypti*, L., used to occur in the District but has not been recorded there for over 30 years. During an intensive inspection made from 1942 to 1945, 32 species were collected as adults in light traps or natural or artificial resting places or while biting, and 26 of them were also taken as larvae. Five species were collected for the first time in the District.

RETIREMENT OF DR. SHEFFIELD A. NEAVE, C.M.G., O.B.E.

The retirement on 31st July of Dr. Sheffield A. Neave, Director of the Imperial Institute (formerly Bureau) of Entomology since 1942, will be deeply regretted, not only by the Executive Council and Staff of the Institute, but by entomologists throughout the world. He is known personally or by repute to a wide circle of entomologists, many of whom have reason to be grateful to him for sympathetic help and sound advice. He will take with him the best wishes of everyone on his retirement.

Dr. Neave was appointed Assistant Director of the then Bureau of Entomology in 1913 whilst serving in Africa as an Entomologist to the Entomological Research Committee (Tropical Africa). He returned to this country in March, 1914, to take up his duties and continued to fill the position until 31st July, 1942, when he succeeded Sir Guy Marshall as Director. His long experience of 33 years on the staff has been wholeheartedly devoted to building up the Institute on the principles originally laid down.

Dr. Neave's outstanding service has been the development of the Institute's Publication Office of which he has been in charge almost since its inception. The principal publication issued by this office is the *Review of Applied Entomology* which first appeared in 1913 and was taken over by Dr. Neave in 1914. It is no exaggeration to say that the "Review" is regarded to-day by economic entomologists, wherever they may be, as the one work that is absolutely indispensable to them. Apart from the many appreciations that have been received from all quarters, the steadily increasing circulation bears testimony to the high value placed on it by entomologists, not only of the British Commonwealth of Nations, but of foreign countries.

In 1939–40 Dr. Neave published his *Nomenclator Zoologicus* in four volumes. This great and painstaking work, containing the names and references of some 100,000 genera of insects, is a standard reference work of the greatest importance to every systematic worker.

The "Review" and the "Nomenclator" represent a major contribution to the advancement of entomological knowledge and they will be a constant reminder for many years to come of Dr. Neave's great service to entomology.

For the past four years Dr. Neave, as Director, has supervised the *Insecta* part of the *Zoological Record* and edited the *Bulletin of Entomological Research* in addition to all his other duties. This period of the later war years and first post-war years has been one of considerable difficulty and the successful manner in which it has been negotiated must be attributed to his ability and wise guidance.

Dr. Neave is being succeeded by Dr. W. J. Hall, M.C., D.Sc., who joined the staff of the Institute in 1943 after 23 years' service in Egypt and Southern Rhodesia, and was appointed Assistant Director in 1944. The latter's place as Assistant Director is being filled by Dr. T. H. C. Taylor, D.Sc., who joined the staff in November, 1944, after 19 years' service in Fiji and Uganda.

J. G. ROBERTSON, *Lt.-Col.*
Chairman of the Executive Council
of the Imperial Agricultural Bureaux.

July, 1946.

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PARKIN (E. A.) & GREEN (A. A.). **Residual Films of D.D.T.**—*Nature* **155** no. 3944 p. 668. London, 1945.

Pieces of absorptive wall-board were sprayed with various concentrations of DDT in commercial kerosene so that equal deposits of DDT were obtained per unit area. They were kept for four days at 27·5°C. [81·5°F.] and 60 per cent. relative humidity, and house-flies [*Musca domestica*, L.] were then confined under petri dishes on the treated surfaces. From the mortality data, DDT was most toxic when it had been applied at a high concentration. When the same samples were tested four weeks after application, the toxicity of the DDT that had been applied at the highest concentrations had increased greatly, and microscopic examination showed that a dense deposit of minute crystals of DDT had formed over the areas exposed to the flies in the first test. Further investigation showed that DDT has a great tendency to supersaturate or supercool, this tendency being more marked in crude than in pure DDT and in solution in kerosene than in solution in acetone. Mechanical agitation, such as the movement of the confined flies or of a soft paint-brush, induces crystallisation of the gum-like residue, which is itself poorly toxic. If the surface remains undisturbed, crystallisation does not occur for several weeks, and much of the toxicity of the residual film remains latent.

DAGGY (R. H.). **The Biology and Seasonal Cycle of *Anopheles farauti* on Espiritu Santo, New Hebrides.**—*Ann. ent. Soc. Amer.* **38** no. 1 pp. 1–13, 9 refs. Columbus, Ohio, 1945.

Anopheles farauti, Lav.,* the mosquito formerly known as *A. punctulatus moluccensis*, Sw. & Sw.,* occurs in the New Hebrides (including the Banks Islands), the Solomons, Bismarck Archipelago, Admiralty Islands and eastern New Guinea [*cf. R.A.E.*, B **33** 79] and is the most important vector of malaria in the Australasian region. It was studied from October 1942 to September 1943 in Espiritu Santo (New Hebrides), where it is the only Anopheline and malaria is hyperendemic. An account is given of the precipitation, geological structure and drainage of the island. *A. farauti* is primarily a coastal mosquito, though the author found it to be abundant at an altitude of 1,100 ft. on Gaua Island in the Banks Group. Permanent breeding places in Espiritu Santo include rivers, streams, springs, taro gardens, seepage areas, ponds, lakes, swamps, marshes, open wells and fresh-water and slightly brackish lagoons. During the rainy season, breeding occurs also in such temporary sites as pools, ruts and hoof-prints. The breeding places vary widely in respect to sunlight, temperature, plant growth, turbidity and movement. Breeding and malaria transmission occur throughout the year wherever water is available, but in the south-eastern part of the Island, where there are few permanent breeding places, transmission takes place principally in the rainy season. At this time, adults are produced in large numbers in all breeding places except some of the larger rivers, from which the larvae are flushed by frequent floods. It is estimated that troops were responsible, principally through the construction of roads and the movement of heavy equipment, for the formation of 90 per cent. of the temporary breeding places in the area in the south-east that has been occupied by them. Moreover, the suitability of some permanent water for breeding was increased. The natives favour the transmission of malaria by building villages near rivers and by making water terraces for growing water taro, a stable food crop.

The flooding of low-lying fresh-water marshes with sea water was considered as a possible control measure, but investigation showed that the maximum

*It appears from a recent key [*R.A.E.*, B **33** 134] that American authorities have concluded that *A. farauti* is specifically distinct from *A. punctulatus*, Dön., and that *moluccensis*, if, as is probable, it is a distinct form, is a sub-species of *farauti* and not of *punctulatus*.

salinity at which breeding can occur is high. Females given a choice of 11 dishes containing water of different salinities varying from rain water to pure sea water oviposited in almost all, including the pure sea water, though they seemed to have some preference for concentrations of less than 50 per cent. sea water. Eggs hatched in pure sea water, but the larvae died in a few hours. However, complete development took place in water containing 13,000 parts chlorides per million (65 per cent. sea water), larvae were found in nature in water containing 13,500 parts chlorides per million (68 per cent. sea water) and larvae taken from such water in the second or third instar completed their development in partly evaporated sea water containing 23,000 parts chlorides per million. Opening low-lying areas to sea water may therefore increase the area available for breeding, but where tidal flushing is marked and the water is not impounded, larvae are greatly reduced in numbers or eliminated.

In individuals reared in the laboratory at 28-30°C. [82·4–86°F.] on dog biscuit, the egg, larval and pupal stages lasted 1½–2, 10 and 1½ days, respectively. The cycle in open, sunlit pools is probably shorter. The females attack man readily, though they also feed on animals. In houses or tents with artificial light, they bit chiefly in shaded corners or on shaded parts of the body. They fed principally, but not exclusively, at night. Their bite is painless and their flight relatively quiet. They sometimes used artificial shelters, such as dwellings, tents, boxes and large tins, as diurnal resting places, but were also found on the walls of slit trenches and the underside of logs. They were never found, however, in standard boxes placed in favourable situations in attempts to estimate adult populations. From observations on the distances between areas in which malaria occurred in the dry season and the nearest breeding places, it was estimated that the effective flight-range of the females is ¾–1 mile, and intensive control measures within this radius considerably reduced the malaria rate. A female was found, together with mosquitos of other species, on a boat 600 yards offshore where the crews of several boats were reporting mosquito annoyance at night and becoming infected with malaria.

Filariasis with nocturnal periodicity is endemic in the New Hebrides. Of the mosquitos occurring there, the only ones in which the complete development of *Filaria* (*Wuchereria*) *bancrofti* has been observed are *A. farauti* [*cf.* **22** 65] and *Culex fatigans*, Wied. (*quinquefasciatus*, auct.), and as the latter is recently introduced and rare, *A. farauti* is probably the important vector.

CALLOT (J.) & DAO VAN TY. **Contribution à l'étude des moustiques français. Culicides de Richelieu (Indre-et-Loire).**—*Ann. Parasit. hum. comp.* **20** no. 1–2 pp. 43–66, 2 pls., 29 refs. Paris, 1945.

Data are given on the habits of 22 species of mosquitos observed at Richelieu (Indre-et-Loire) between 1936 and 1943. The species of *Anopheles* were *A. claviger*, Mg., *A. plumbeus*, Stephens, and *A. maculipennis*, Mg., which is represented by vars. *typicus*, *messeae*, Flni., *melanoon*, Hackett, and *atroparvus*, van Thiel. Attempts to make *A. claviger* mate in a confined space failed [*cf.* *R.A.E.*, B **28** 128]. Larvae of this Anopheline were found in forest ditches rich in decaying vegetable matter and also in water stored for use in gardens, in flooded meadows and in hoof prints, which were not always sheltered or shaded. The adults were present from the end of March until October, and the females attacked man and animals throughout this period as long as temperatures were high enough. Larvae of all instars were numerous at the end of October, those of the second instar particularly so. Second- and third-instar larvae were found in winter, although some workers have thought that hibernation occurs only in the fourth instar. The authors believe that there is no true diapause [*cf.* **21** 162; **24** 139; **32** 48] but that development is retarded by external conditions. Larvae taken in nature in winter were induced to develop to the

adult stage by a modification of temperature. The females bite during the day in shady and sheltered places. They were never found in houses, but were taken in animal shelters even at the end of October.

A. plumbeus was not common at Richelieu, as potential breeding places were few. There were three permanent ones, all cavities formed by the multiple trunks of oak trees. Eggs and larvae were also found in June in a hole in an oak log containing brown water, the temperature of which was sometimes as high as 25°C. [77°F.]. The temperature in the other breeding places rarely exceeded 15°C. [59°F.], the level reached when the air temperature was 27°C. [80·6°F.]. Adults appeared in late April or early May and eggs in early June. There were several generations before the beginning of October, from which time only larvae were found. Man was attacked in undergrowth, but not very frequently.

A. maculipennis is probably the most widespread mosquito in France with the exception of *Culex pipiens*, L. At Richelieu, several generations are produced between early April, when oviposition begins, and September. The females feed on animals more often than on man and are seldom found in houses. They hibernate from October to late March in uninhabited buildings, stables and sheds in which animals are kept. Eggs of *A. m. melanoon* were seen during the later years of the work in various breeding places, particularly cement tanks. *A. m. messeae*, which seemed to be the most widespread variety, and *A. m. typicus*, bred in almost still water in canals and in sheltered or unsheltered grassy ditches. *A. m. atroparvus* was not uncommon ; its eggs were found for several years in cement tanks in which they were subsequently replaced by those of *melanoon*, and in 1942, they occurred in the same breeding places as those of *messeae*. A list is given of the inland districts of France from which *atroparvus* is known, with references to the papers in which the occurrence was recorded.

Brumpt (E.). **Anophélisme sans paludisme et régression spontanée du paludisme.**—*Ann. Parasit. hum. comp.* **20** no. 1–2 pp. 67–91, 4 pp. refs. Paris, 1945.

The three factors involved in the transmission of malaria, the *Plasmodium*, the Anopheline and the susceptible person, are discussed in turn in relation to the disappearance of malaria from certain parts of Europe in the absence of measures designed to eradicate it. The vector concerned was *Anopheles maculipennis*, Mg., and the parasite was probably in every case *P. vivax*, the local strains of which are mild and yield easily to treatment with quinine. The regions under discussion are in the cooler parts of Europe and have a climate that allows of transmission for only a few weeks each year. European *P. vivax* apparently cannot develop in the mosquito at a mean temperature lower than 15·5–16°C. [59·9–60·8°F.], but in some countries, notably Holland, where this temperature is not reached every year out-of-doors, it is transmitted by Anophelines that shelter in buildings where the temperature is higher.

The absence of malaria in certain regions in which *A. maculipennis* is present is explained by the local preponderance of recently recognised races that rarely attack man. There are many instances of this in Italy. The theory that in the regions from which malaria has receded, the Anopheline vectors have changed from anthropophilic to zoophilic habits is rejected [*cf. R.A.E.*, B **20** 71], and the substitution of harmless for dangerous races or species, though it has taken place in some countries, cannot be accepted as a satisfactory explanation of the phenomenon as a whole as malaria has receded from some districts, for instance Normandy, where no agricultural or other changes that could account for an alteration in the Anopheline fauna, have been made for a hundred years. Moreover, the occurrence of minor epidemics on the introduction of gametocyte carriers during the wars of 1914–18 and 1939–45

shows that both vectors and susceptible persons were present in sufficient numbers. The change must therefore have been brought about by a reduction in the number of gametocyte carriers.

Thirteen suggested explanations of the so-called spontaneous disappearance of malaria are reviewed from the literature, and it is concluded that the reduction in the number of gametocyte carriers has been brought about by improved social and economic conditions, with consequent increased use of quinine, accompanied by a decrease in the child population. In northern Holland, malaria persists in spite of the relative prosperity of the rural population, the administration of quinine and the fact that the climate is at the limit suitable for the development of the parasite in the mosquito, but it does so only in large families living in crowded conditions where *A. m. atroparvus*, van Thiel, can become infected and transmit the disease to young children.

CALLOT (J.). **A propos de** *Aëdes* (*Finlaya*) *heracleensis* **Callot 1944.**—*Ann. Parasit. hum. comp.* **20** no. 1–2 pp. 93–94, 2 refs. Paris, 1945.

The author has found that the mosquito recently described by him as *Aëdes* (*Finlaya*) *heracleensis* [*R.A.E.*, B **33** 100] is identical with *A.* (*Ochlerotatus*) *longitubus*, Cambournac [**26** 104].

MUNRO (J. A.), REDMAN (K.) & LONGWELL (J. H.). **Effectiveness of DDT against Flies in Livestock Barns.**—*Bi-m. Bull. N. Dak. agric. Exp. Sta.* **7** no. 5 pp. 21–23, 2 figs. Fargo, N. Dak., 1945.

A dust of 10 per cent. DDT in pyrophyllite was applied to the interior of a dairy barn in North Dakota on 25th July 1944 directly after the cows had been brought in. The floor had just been swept and most of the windows closed. Flies began to fall within 15 minutes, and an hour after dusting the cows could be milked without the application of a fly-spray, which had been necessary on the preceding days. However, kill diminished rapidly, and a fly-spray had to be used again from the third day after treatment. On 10th August, a spray of 1 U.S. pint 25 per cent. DDT self-emulsifying concentrate in 20 U.S. gals. water (with the addition of 0·28 lb. copper sulphate as a fungicide) was applied at a pressure of 125–150 lb. to the interior of a pig barn, several doors of which were open. In 24 hours, there were 45 dead flies per sq. ft. of floor surface. On 15th–18th August, inclusive, the rates were 13, 14, 2 and 27 flies per sq. ft., respectively, the greatest numbers being killed on warm days. Weekly observations for the next month showed that the toxicity of the DDT residue was maintained. Observations then ceased as the fly season was nearly over. The catch in a large fly-trap near the building fell off rapidly after the DDT was applied. Occasional inspections of other treated buildings indicated results comparable with the two reported. Stable flies [*Stomoxys calcitrans*, L.] comprised 17½ per cent. of the kill and house-flies [*Musca domestica*, L.] the remainder. Before the DDT spray was used, the pigs had sores behind the ears apparently caused by stable flies, but the areas were healing within a week of spraying, and no further injury was noticed during the season.

JONES (H. A.), FLUNO (H. T.) & HENDRICK (A. B.). **DDT insecticidal Preparations.**—*J. econ. Ent.* **38** no. 2 pp. 207–210. Menasha, Wis., 1945.

This paper deals with some of the DDT preparations developed in Florida for use against insects affecting the armed forces. Commercial DDT is difficult to grind into a dust by itself because of its low melting point [*cf. R.A.E.*, B **34** 98], but it can readily be ground with an inert diluent, of which at least

70 per cent. should be present when large quantities are involved. Commercially ground dusts of DDT in inert carriers form the louse powder and mosquito larvicide now in use in the armed forces. In the earlier stages of work on DDT as an Anopheline larvicide, emphasis was placed on the preparation of non-wettable dusts. The many materials tested as diluents included stearic acid and metallic stearates. Stearic acid forms with DDT a solid solution that can be prepared in various ways. Melting the two constituents and spraying gave a dust with particles 14 microns in diameter that was not readily wetted by water. Its dusting property was markedly improved by the addition of calcium stearate. The addition of magnesium carbonate also facilitated dusting, as well as grinding when the method of preparation involved this.

The solubility of pure DDT in 18 of the more useful solvents at 27–30°C. [80·6–86°F.] is given. Technical samples are generally somewhat more soluble than the pure material. Solution in kerosene is recommended for sprays designed to leave a residue toxic to insects, and solution in fuel oil and higher boiling oils for Anopheline larvicides. Underwear has been rendered proof against lice [*Pediculus humanus*, L.] by dipping in solutions of DDT in a volatile petroleum solvent. Cyclohexanone is used as an auxiliary solvent to increase the solubility of DDT in petroleum oils. When a 10 per cent. DDT solution is desired, about 10 per cent. cyclohexanone is added. Benzene, xylene and orthodichlorbenzene have also been used as auxiliary solvents, and cyclohexanone facilitates the incorporation of DDT in dichlordifluoromethane.

The qualities required of an all-purpose DDT emulsion concentrate [*cf. loc. cit.*] are given. The solvents must have a low specific gravity and be capable of dissolving large amounts of DDT. About 100 emulsifiers and combinations of emulsifiers have been tested with a large number of solvents, and a concentrate containing DDT and an emulsifier in a water-immiscible solvent and forming a very stable emulsion in water has been developed. The emulsion prepared from it can be used as a mosquito larvicide, as a spray that leaves a residue toxic to mosquitos, house-flies [*Musca domestica*, L.] or bed-bugs [*Cimex*] or to make clothing louse-proof. A fairly satisfactory emulsion can be made by stirring together a solution of DDT in an aromatic hydrocarbon and a 1 per cent. solution of soap in water.

A suspension in water of powdered DDT and talc with a wetting agent kept agitated while in use and a similar suspension made by adding the DDT and talc to soapy water make effective sprays for leaving a toxic residue. Colloidal suspensions prepared by dissolving DDT in a water-miscible solvent with a wetting agent and adding the solution to water are much more stable at very low than at high concentrations and might therefore be useful as mosquito larvicides where lasting effect is desired.

Crayons of DDT prepared for use against cockroaches [*cf.* **31** 198] left a good deposit when drawn across a surface. DDT has also been incorporated in furniture polish, oil paints and lacquers, and though not fully effective in these vehicles [*cf.* **34** 62] may have specialised uses in them.

Bushland (R. C.), McAlister jr. (L. C.), Jones (H. A.) & Culpepper (G. H.). **DDT Powder for the Control of Lice attacking Man.**—*J. econ. Ent.* **38** no. 2 pp. 210–217, 3 refs. Menasha, Wis., 1945.

Descriptions are given of the beaker [*R.A.E.*, B **34** 45] and arm-and-leg [**33** 109] methods of testing the toxicity of insecticides to *Pediculus humanus humanus*, L. (*P. h. corporis*, Deg.) and of the procedure for making tests on grossly infested persons [**34** 45], together with the results of tests of DDT made by these methods in Florida. The following is based on the authors' summary. In arm-and-leg tests, a powder containing 0·25 per cent. DDT

caused complete mortality of *P. humanus* after 24 hours but had little lasting quality. Powders containing 1 per cent. DDT usually gave complete kill for 8–10 days, a 5 per cent. powder was effective for 14–16 days, and a 10 per cent. powder generally gave complete kill for 30–40 days. In tests on grossly infested subjects, a powder containing 10 per cent. DDT gave practically complete kill of lice for three weeks (*cf.* **32** 197), and a powder of this strength with pyrophyllite as the diluent was recommended to the armed forces (**32** 39) in May 1943. All lice exposed to 10 per cent. powder were prevented from feeding in 3·5 hours, knocked down in six hours and dead in 20 hours. Lice starved for several hours were more susceptible than freshly fed ones. Mechanical mixtures of DDT and powder diluent were as effective as powders prepared by wetting the carrier with an acetone solution of DDT, allowing it to dry and then grinding it. Pyrophyllite and certain grades of talc were the most suitable of the diluents tried. The particle size of the DDT within the range tested (6–17 microns) did not appreciably influence the effectiveness of the powder. Dusts made with pyrophyllite with particle sizes of 5 microns or less were more effective than those made with a diluent having larger particles. A powder containing 10 per cent. DDT retained its effectiveness after exposure to the open air for several months or storage at 140°F. for two months, but lost about half its toxicity after ten months at 140°F. Garments dusted with DDT remained effective against lice after one washing in warm soapy water but not after two. Of more than 100 compounds tested, none showed marked synergistic action for DDT. The addition of an oil to 5 per cent. DDT powder did not prolong its effectiveness. The powder containing 10 per cent. DDT was highly effective against *Phthirus pubis*, L., in the cases treated, of which there were more than 100.

Jones (H. A.), McAlister jr. (L. C.), Bushland (R. C.) & Knipling (E. F.). **DDT Impregnation of Underwear for Control of Body Lice.**—*J. econ. Ent.* **38** no. 2 pp. 217–223, 1 fig., 4 refs. Menasha, Wis., 1945.

The following is based on the authors' summary and conclusions. To study the effect of impregnating underwear with DDT as a means of controlling lice (*Pediculus humanus*, L.) on man (*cf. R.A.E.*, B **32** 197), cotton garments and others containing 50 per cent. wool were treated with solutions and emulsions of DDT at different concentrations and lice were introduced at various intervals after the treatment. Some garments were washed periodically and others worn continuously without laundering. There was no marked difference between results with the two kinds of underwear. In arm-and-leg tests (**33** 109), sleeves treated with 0·05, 0·5 and 1 per cent. DDT in solution remained effective for more than a week and after three and four weekly washings, respectively. Dry cleaning reduced effectiveness more than laundering. In general, the duration of effectiveness was about the same whether solutions or emulsions were used. Sleeves treated with solutions showed no decrease in effectiveness after being stored for a year. Two-piece suits of underwear containing 50 per cent. wool that had been treated with 10 and 20 gm. DDT remained highly effective after five and nine or ten washings, respectively. On the basis of these results, a dosage of 15 gm. or 2 per cent. of the weight of the garment, is recommended to give protection against lice through 6–8 washings.

A description is given of a portable outfit for the impregnation of garments with DDT and the procedure followed in using it. It consisted of an army water-sterilising bag with a capacity of 30 U.S. gals. mounted on a frame to which a wringer was clamped. One filling of the bag was sufficient to impregnate 186 lb. part-woollen underwear. A description is also given of the procedure used in carrying out large-scale treatment in standard laundry equipment. Over 5,000 suits were treated with emulsion to give a dosage of 2 per cent. of the

weight of the garment. Such suits gave protection from infestation through 6–8 washings. An unwashed suit still killed all lice after it had been worn for six months. It is suggested that if underwear is to be impregnated in the United States, a solution in a volatile solvent should be used in dry-cleaning equipment. An emulsion used in the unit described, in mobile laundry units or in any suitable small container is recommended for overseas.

GAHAN (J. B.) & LINDQUIST (A. W.). **DDT Residual Sprays applied in Buildings to control** *Anopheles quadrimaculatus*.—*J. econ. Ent.* **38** no. 2 pp. 223–230. Menasha, Wis., 1945.

An account is given of a large-scale practical test carried out in a rice-growing area of Arkansas in 1944 to determine the duration of effectiveness of the residue from a single application of DDT spray against *Anopheles quadrimaculatus*, Say, and to ascertain whether the general population of this species occurring in the immediate neighbourhood of sprayed buildings could be reduced by the DDT sprays without other control measures. The sprays were applied as water emulsions or solutions in kerosene to the inside walls and ceilings of nearly every building and the underside of all bridges and culverts and to miscellaneous equipment in two areas of nine square miles each. The rate of application was 208 mg. DDT per sq. ft. in one area and 56 mg. in the other. The solutions caused irritation to the operators, but the emulsions, which appeared to give equally effective deposits, did not. The degree of control was determined by comparing the numbers of mosquitos found in the treated areas with those occurring in similar areas that were not sprayed.

Ten afternoon counts were made in the buildings between June and October, the last count 3½–4½ months after the sprays had been applied. The heavier residue reduced the number of mosquitos resting in the buildings by over 99 per cent. and the lighter one by 91 per cent., throughout the season. More mosquitos were found early in the morning than in the afternoon, but their numbers were reduced very considerably in treated buildings even in the morning. It is doubtful whether the results indicated a great reduction in the number of mosquitos in the neighbourhood, as mosquitos certainly entered throughout the night and left again after coming into contact with the DDT. Tests showed that most of the mosquitos that leave subsequently die, but there was a very high mortality among controls, which is attributed to the weather. As the DDT is not repellent, the chances are considerable that mosquitos that acquire malaria parasites will rest on a treated surface long enough to obtain a lethal dose of DDT and die before they reach the infective stage. Since it is desirable to eliminate as many mosquitos as possible, the heavier deposit should be used under the population conditions occurring in the test area. An attempt was made to determine the relative abundance of *A. quadrimaculatus* inside and outside the treated areas by placing nail kegs at random under bushes and trees bordering roads, but the results were too erratic to give a true index of the relative numbers present. Counts of Anopheline larvae in rice-fields indicated reductions of 63 and 57 per cent., respectively, in the heavily and lightly treated areas.

GAHAN (J. B.), TRAVIS (B. V.), MORTON (F. A.) & LINDQUIST (A. W.). **DDT as a residual-type Treatment to control** *Anopheles quadrimaculatus*: **practical Tests.**—*J. econ. Ent.* **38** no. 2 pp. 231–235, 2 refs. Menasha, Wis., 1945.

In practical tests carried out in Florida and Arkansas in 1943, DDT applied in water emulsions, water suspensions or kerosene solutions at dosages ranging from 65 to 400 mg. per sq. ft. protected buildings from natural infestations of *Anopheles quadrimaculatus*, Say, for as long as ten weeks. The treatment often eliminated the mosquitos. When it did not, the numbers present were always

much lower than before spraying or in untreated buildings used as controls. The DDT activated the mosquitos and caused many of them to leave the building, but investigation showed that a large percentage of those that escaped had obtained a lethal dose. In one test, many thousand adults of *Psorophora* were killed when a light was used to attract them to a building treated with a water suspension of 1 per cent. DDT.

In a simulated practical test, complete mortality was obtained over a period of 84 days when adults of *A. quadrimaculatus* reared in the laboratory were confined in a treated room for 24 hours. Once, however, some mosquitos continued to bite a man exposed in this room until a knockdown of 99 per cent. had occurred. The time required to knock down all mosquitos gradually increased with the length of the period after application. After 98 and 100 days, 4 per cent. of the mosquitos survived the exposure, and the test was then discontinued.

These tests indicate that one or two thorough sprayings per season may keep buildings relatively free of *A. quadrimaculatus*. Sprays should be applied directly to the walls and ceilings. Fogging of the air is unnecessary, and a coarse spray is preferable to a mist.

GAHAN (J. B.), TRAVIS (B. V.) & LINDQUIST (A. W.). **DDT as a residual-type Spray to control Disease-carrying Mosquitoes. Laboratory Tests.**—*J. econ. Ent.* **38** no. 2 pp. 236–240, 7 refs. Menasha, Wis., 1945.

In laboratory tests in Florida in 1943, DDT applied in sprays on wooden boxes and canvas cages at 10–400 mg. per sq. ft. left residues effective against adults of *Anopheles quadrimaculatus*, Say, and *Aëdes aegypti*, L. There was no great difference in susceptibility between the two species, but *A. aegypti* was knocked down rather more quickly and was therefore abandoned as a test insect early in the studies. A water emulsion and a water suspension were equally effective on wood, and both were slightly superior to a kerosene solution at 50 and 100 mg. DDT per sq. ft. Increasing the dosage from 50 to 400 mg. per sq. ft. slightly shortened the time required to effect knockdown but not sufficiently to justify the heavier deposit. The water emulsion and suspension most extensively used left a visible deposit on some painted and varnished woods whereas residues from kerosene solutions and some other water emulsions were practically invisible. An exposure period of at least 2–4 hours was required for all mosquitos to obtain a lethal dose. Many of the residues were still completely effective after 32 weeks when mosquitos were exposed for 24 hours, and one was effective after 52 weeks. Sunlight had a deleterious effect on the residue, but the loss in toxicity was very slow, for a deposit of 50 mg. did not fail to kill mosquitos until after 24 weeks. As Anophelines normally rest in dark places, this is probably of little practical importance. DDT residues were highly toxic on unpainted surfaces and on surfaces covered with two coats of cold water and casein paint that had been applied less than two weeks earlier, 50 mg. still giving complete kill after 32 weeks, but they were much less effective on surfaces that had recently been painted with oil paint, on which mortalities below 100 per cent. were obtained one week after treatment. The DDT activated the mosquitos that rested on treated surfaces and caused them to fly, but not before most of them had obtained a lethal dose.

DEONIER (C. C.), MAPLE (J. D.), JONES (H. A.), HINCHEY (E.) & EIDE (P. M.). **DDT as an Anopheline Larvicide—Laboratory Tests.**—*J. econ. Ent.* **38** no. 2 pp. 241–243. Menasha, Wis., 1945.

The high toxicity and physical properties of DDT make it very suitable and adaptable for use as a mosquito larvicide. An account is given of laboratory tests in Florida on its effectiveness against larvae of *Anopheles quadrimaculatus*,

Say, when applied by various methods and at different dosages. To simulate the weathering of surface applications in the field, treated jars were subjected to repeated artificial rains of 6 ins. in 4–5 minutes.

DDT as a 0·1 per cent. dust in talc was toxic to 100 and 62 per cent. of the larvae, respectively, when used at the rates of 0·005 and 0·0001 lb. DDT per acre. A 5 per cent. Paris green dust gave 85 per cent. mortality in 48 hours when applied at 0·1 lb. Paris green per acre. In practice DDT can be used at a strength as low as 1 per cent. without its efficiency being impaired, whereas a large percentage of carrier reduces the efficiency of Paris green. The effectiveness of Paris green was also greatly reduced after one artificial rain. Dusts prepared by mechanical mixing of DDT with various diluents, particularly the waxy solid fatty acids, higher alcohols and esters, were resistant to sinking due to rain, and solid solutions of DDT in these materials were especially resistant. A solid solution of 20 per cent. DDT in stearic acid was made into a dust with a specific gravity almost equal to that of water, but it did not mix well. Its dusting qualities were improved by mechanically mixing with a powder such as talc or calcium stearate. A dust of 20 per cent. DDT in talc applied at 0·5 lb. per acre and subjected to artificial rain on the day of application and on alternate days thereafter remained effective for an average of 30 days, and one of 20 per cent. DDT in stearic acid was effective for 38 days under the same conditions. When equal parts of calcium stearate and stearic acid solution of DDT were used, mortalities above 80 per cent. were obtained for 86 days with 44 artificial rains. Resistance to sinking by artificial rain was influenced by particle size ; a dust containing DDT that would pass a 200-mesh screen was rendered ineffective by three rains, but one containing micronised DDT resisted 14–20.

As a suspension made from an acetone solution, DDT gave average mortalities of 98·2, 55·5 and 23·2 per cent. in 48 hours at 0·01, 0·005 and 0·0025 parts per million, respectively. In a comparison of the toxicity of acetone suspensions of DDT and phenothiazine, mortality percentages averaged 100, 94 and 55 for DDT at 0·01, 0·005 and 0·0025 p.p.m. and 79, 10 and 7 for phenothiazine at 1, 0·1 and 0·05 p.p.m., respectively. DDT in petroleum oil gave effective control at dosages as low as 0·1 and 0·05 lb. DDT per acre. It was also effective in all emulsions and suspensions tried. In stable emulsions and suspensions, it remained effective for a long time at 0·1 p.p.m., and for 8–10 days at 0·01 p.p.m.

Deonier (C. C.), Burrell (R. W.), Maple (J. D.) & Cochran (J. H.). **DDT as an Anopheline Larvicide : preliminary Field Studies.**—*J. econ. Ent.* **38** no. 2 pp. 244–249, 2 refs. Menasha, Wis., 1945.

In field tests in Florida in 1943, dusts of 1 per cent. DDT in talc gave satisfactory initial control of larvae of *Anopheles quadrimaculatus*, Say, and *A. crucians*, Wied., at dosages as low as 0·05 and 0·1 lb. DDT per acre, but the rates of application were too low for lasting effect, and breeding was resumed within a few days. A dust containing 20 per cent. DDT at 1-2 lb. DDT per acre gave control for 6–8 weeks or more among vegetation of the type of water hyacinth (*Eichhornia crassipes*). Heavy treatments usually reduced breeding for 1–2 weeks in areas with light to moderate vegetation, but wind action and other surface disturbances broke up the protective dust cover, so that breeding could be resumed. In average vegetation, 5 per cent. DDT in petroleum oil was effective at a dosage of only 1 U.S. quart oil (0·1 lb. DDT) per acre, but a larger quantity of oil may be needed to give adequate coverage in many situations. There was no significant difference between 0·6, 1·0 and 5·0 per cent. DDT in oil when applied at 0·1 lb. per acre. Application may be made by pouring or spraying, by releasing from dispensers or porous materials, or by various special methods developed for other larvicidal oils. A long-lasting treatment may be obtained by the slow release of a larvicide in oil. Wind and

wave action in breeding areas with light or moderate vegetation break up the surface film of oils and DDT deposits just as they do dusts.

DDT in suspensions and emulsions made a very efficient larvicide. One concentrate of 10 per cent. DDT in 80 per cent. cellosolve (ethylene glycol monoethyl ether) with 10 per cent. Nopco 1216 (sulphonated sperm oil) gives a very stable suspension in which the solvent is miscible with water, leaving the DDT in colloidal suspension. Another composed of 20 per cent. DDT, 20 per cent. Triton X-100 (an aralkyl polyether alcohol) and 60 per cent. xylene forms an emulsion when mixed with water, and the DDT remains in solution in the water-immiscible xylene, which is dispersed in colloidal-sized droplets. This emulsion was toxic at 0·05 parts DDT per million in both fresh and brackish waters. Higher concentrations of DDT in stable suspensions have retained their larvicidal action for three months, but such suspensions were toxic to cold-blooded vertebrates. DDT mixtures in concentrated form would greatly simplify problems of transport and treatment.

Wisecup (C. B.) & Deonier (C. C.). **DDT for the Control of *Psorophora* Mosquitoes.**—*J. econ. Ent.* **38** no. 2 pp. 250–252. Menasha, Wis., 1945.

Mosquitos of the genus *Psorophora* are very troublesome pests in the south-eastern United States, and the principal species in peninsular Florida are *P. confinnis*, Lynch (*columbiae*, D. & K.) and *P. ciliata*, F. Throughout the Orlando area, the eggs are laid in autumn in roadside ditches and damp grassy depressions, and adults appear within a week of the first spring rains. If the spring floods are extensive, the areas over which the eggs hatch simultaneously are too large to be treated during the short period in which the larvae are present, and the value of DDT for treating favourable environments before hatching was therefore investigated in March and April 1944. Dusts containing 20 and 1 per cent. DDT in talc and applied at 1 and 0·1 lb. DDT per acre were not effective at the first flooding after weathering for 28 and 17 days, respectively. Sprays of 5 per cent. DDT in fuel oil and 20 per cent. DDT in xylene emulsion gave perfect control at 0·1 and 0·2 lb. DDT per acre, respectively, when two weeks elapsed before flooding of the treated area. Recently hatched larvae could be found, but no subsequent development took place. Self-operating oil dispensers so placed that they released oil containing 5 per cent. DDT when they were flooded and applied 0·1 lb. DDT or more per acre gave perfect control at the first flooding, but these treatments and a spray that also gave complete control at the first flooding were almost or quite ineffective when the areas were flooded a second time, indicating that it will probably be necessary to repeat treatments during periods between rains.

Surface applications of DDT at 0·1 lb. per acre made after the eggs had hatched gave satisfactory control of all but the largest larvae, whether they took the form of dusts or sprays or were made in oil-impregnated sawdust or poured oil. The drifting of mechanically dispersed mists gave good control of young larvae, but was not very effective against older ones. It is concluded that effective control of *Psorophora* can probably be obtained with DDT at dosages considerably below 0·1 lb. per acre.

Madden (A. H.), Lindquist (A. W.) & Knipling (E. F.). **DDT Treatment of Airplanes to prevent Introduction of noxious Insects.**—*J. econ. Ent.* **38** no. 2 pp. 252–254, 1 ref. Menasha, Wis., 1945.

Experiments in Florida indicated that DDT applied to the interior of aircraft can leave a residue toxic to mosquitos and house-flies [*Musca domestica*, L.] for at least six weeks. In the preliminary tests, the deposits from most sprays of DDT in different solvents and from a dust containing 50 per cent. DDT in talc, all of which were applied at 100 mg. DDT per sq. ft. to glass surfaces, were

resistant to wiping with a dry cloth. The spray deposits were no more effective than the dust after two wipings but were superior after a third. None of the treatments was completely resistant to washing with soap and water. In tests with cages made of glass and aluminium to simulate a section of an aeroplane fuselage, the deposit from 20 per cent. DDT in talc was slower in action than that from the same percentage in kerosene, particularly in effecting knock-down of mosquitos. Wiping the cages with a dry cloth 11 days after treatment reduced the knock-down rate of mosquitos and flies. Washing them with kerosene 19 days after treatment markedly decreased the action of the dust, but had no noticeable effect on that of the spray. In the practical tests, DDT at concentrations of 5 and 20 per cent. in kerosene, 20 per cent. in an aqueous emulsion and 50 per cent. in a dust with talc was applied to aircraft in operational use, flies and mosquitos, including *Anopheles quadrimaculatus*, Say, *Culex fatigans*, Wied. (*quinquefasciatus*, auct.) and *Aëdes aegypti*, L., were subsequently exposed in the aircraft for 1½–2 hours and the percentages knocked down were recorded, as insects knocked down by DDT do not normally recover. Two tests with an aerosol containing 5 per cent. DDT and 0·2 per cent. pyrethrins were also made. The dust and the aerosol were the easiest forms in which the DDT could be applied, a fine-mist spray was next and a coarse spray last. Applications were made with the doors, windows and hatches closed, and in the confined space, all the sprays were very irritating. The deposit from the aerosol gave 42 per cent. knock-down of house-flies after three weeks in an aeroplane with an upholstered interior, and no knock-down after two weeks in one with an uncovered metal interior. Dusts gave a maximum knock-down of 42 per cent. of mosquitos in aeroplanes with metal interiors at the end of two weeks but complete knock-down after six weeks in an upholstered aeroplane. Coarse sprays containing 5 per cent. DDT gave 80 per cent. knock-down of mosquitos six weeks after application. Slightly better results were obtained with 20 per cent. DDT in kerosene applied as a fine-mist spray, and only about one-fifth as much solution was required. This spray applied at 350 mg. DDT per sq. ft. gave complete knock-down of flies and mosquitos in two hours after 12 days. This dosage is probably higher than is necessary. The shorter duration of the effectiveness of dusts as compared with sprays and the unsightliness of the deposit counterbalance the greater ease of application.

These tests are thought to indicate that treatment with DDT to leave a toxic residue represents a useful supplement to the pyrethrum aerosol now used for the immediate control of insects in aircraft. It will give protection where the aerosol is improperly applied or omitted, and provide a means of treating parts of the aircraft that cannot be successfully dealt with by means of an aerosol. It may not be a satisfactory substitute for the aerosol treatment, as during a short journey or in the presence of untreated articles, insects might not rest on treated surfaces long enough to obtain a toxic dose. No harmful effects were produced by the DDT deposit or the solvents on the aeroplane or the occupants.

Lindquist (A. W.), Travis (B. V.), Madden (A. H.), Schroeder (H. O.) & Jones (H. A.). **DDT and Pyrethrum Aerosols to control Mosquitoes and Houseflies under semi-practical Conditions.**—*J. econ. Ent.* **38** no. 2 pp. 255–257, 2 refs. Menasha, Wis., 1945.

Tests are described of the effectiveness against *Anopheles quadrimaculatus*, Say, and *Musca domestica*, L., of aerosols produced by dispersing solutions of pyrethrum extract and DDT in dichlordifluoromethane (Freon-12). The formulae for the aerosols are not given. The tests were made in closed rooms through which the aerosol was distributed evenly with a fan. Mosquitos and house-flies were then exposed for one and five minutes, respectively, by carrying them round the room in wire gauze cages, after which they were transferred to clean cages. To obtain the necessary concentration of DDT in

Freon-12, an auxiliary solvent had to be used. Cyclohexanone was the most satisfactory. Equal amounts of total solution were applied, but the concentration of DDT was 12·5 times that of pyrethrins. The following is mainly from the authors' summary. The DDT aerosol was as toxic as the pyrethrum aerosol to the mosquitos, and far more toxic to the house-flies, but the knock-down of both obtained with it after ten minutes was relatively poor. The knock-down properties of pyrethrum and the toxicity of DDT to house-flies were combined by using aerosols containing both. None of the toxicity of DDT to house-flies was lost and the toxicity to mosquitos was slightly greater than that obtained with the standard pyrethrum aerosol (0·4 per cent. pyrethrins and 8 per cent. sesame oil in Freon-12). The addition of motor oil made it possible to secure the desired effect at reduced concentrations of DDT and cyclohexanone.

Lindquist (A. W.), Madden (A. H.), Wilson (H. G.) & Knipling (E. F.). **DDT as a residual-type Treatment for Control of Houseflies.**—*J. econ. Ent.* **38** no. 2 pp. 257–261, 2 refs. Menasha, Wis., 1945.

In experiments carried out in Florida in 1943 on the toxicity of the residue left by DDT sprays, five-day-old adults of *Musca domestica*, L., were introduced into treated cages of various types to determine the effect of short periods of exposure and the time required for knock-down with continuous exposure. The temperature during the tests was 80–90°F. The knock-down for the short exposures was recorded after six hours, and the kill after 24 and 48 hours. When flies were exposed for one or five minutes in wooden boxes treated at the rate of 125 mg. DDT per sq. ft. and then transferred to clean cages, boxes treated with 5 per cent. DDT plus 5 per cent. cyclohexanone in deodorised kerosene (Deobase) gave better knock-down and kill in 11 tests at intervals over a period of 207 days than those treated with 5 per cent. DDT in kerosene. The mortalities recorded 24 hours after exposures of one and five minutes averaged 80 and 95 per cent. for the solution with cyclohexanone and 57 and 90 per cent. for the one without it, there was little further mortality 48 hours after exposure, and no evidence of loss of toxicity of the deposits during the period of the tests. When applied to wire-gauze cages with a paint brush at the rate of 100 mg. DDT per sq. ft., 10 per cent. DDT gave much better knock-down and kill of flies exposed for one or five minutes when it was dissolved in kerosene with cyclohexanone than in dibutyl phthalate. In cages of synthetic gauze treated at 100 mg. DDT per sq. ft., with 5 per cent. DDT in solution in kerosene or dibutyl phthalate, as an emulsion with 5 per cent. Triton X-100 (an aralkyl polyether alcohol) and 15 per cent. xylene in water, and as a water suspension with 5 per cent. talc and 2 per cent. Dreft (sodium lauryl sulphate), the suspension gave the best results against flies exposed for one and five minutes over a period of 147 days, though mortality was frequently complete or nearly so in all cases. None of the treatments damaged the synthetic material. These results suggest that DDT treatment of gauze doors, windows and porches may be an effective measure. When applied at 50 mg. DDT per sq. ft. to surfaces painted three weeks previously, the DDT suspension was more effective than the solution in kerosene, but since the suspension leaves a visible deposit it might be of limited use.

The time required for knock-down of all flies introduced into plastered boxes treated at 25 mg. per sq. ft. with DDT in kerosene and in an emulsion was about 100 minutes over a period of 200 days after treatment. This was about equal to the knock-down time obtained with the same treatment on unpainted wooden surfaces. The time of knock-down of all flies introduced into plastered rooms containing furniture and previously sprayed with DDT solutions ranged from 1·5 to 4 hours over a period of six weeks. It is probable that the flies did not come in contact with the treated surfaces so frequently as in boxes.

All flies were killed by exposure in wooden cages treated with 1 per cent. DDT in calcimine (a cold-water paint) at 25 mg. DDT per sq. ft., but the knock-down was not so rapid as that effected by DDT in kerosene. Strips of muslin dipped in DDT solutions at 2–3 gm. DDT per sq. ft., squeezed out and allowed to dry were hung in a fly-rearing room. They gave almost complete kill of flies overnight, and remained effective for 150 days. A solution of 10 per cent. DDT and 10 per cent. cyclohexanone in Deobase was satisfactory. This type of treatment might be applied to lamp cords where flies rest. DDT dissolved in furniture polish and applied to mess-hall tables is reported to have been effective. The mixture gave rapid knock-down in boxes on unpainted wood, but poor results on newly lacquered surfaces.

Lindquist (A. W.), Wilson (H. G.), Schroeder (H. O.) & Madden (A. H.). **Effect of Temperatures on Knockdown and Kill of Houseflies exposed to DDT.**—*J. econ. Ent.* **38** no. 2 pp. 261–264. Menasha, Wis., 1945.

An account is given of experiments on the effect of temperature on the toxicity of DDT to house-flies (*Musca domestica*, L.) exposed at 60–70 per cent. relative humidity in cages treated with known dosages of 5 per cent. DDT in kerosene. Rapid recovery was observed when flies that had been knocked down in treated cages at 70°F. were transferred to a temperature of 80–100°F. All the flies were down again in a few seconds when returned to a temperature of 70°F. and again became active when exposed once more to a higher temperature. This could be repeated several times before death occurred. When flies were exposed continuously in wooden boxes treated three months previously with 50 mg. DDT per sq. ft., the time required for both 50 per cent. and complete knock-down increased as the temperature increased from 50 to 95°F. The effect of temperature on mortality was studied by exposing flies at 65 or 70 and 95°F. in boxes or cages treated 2–152 days previously with different dosages of DDT and, when knock-down was complete, transferring them to clean cages at 70, 90 and 100°F. No flies became active within an hour and complete mortality was always obtained when the flies were kept at 70°F., irrespective of the temperature at the time of exposure. When kept at the higher temperatures, some flies became active within one hour and mortality after 24 hours was often less than 100 per cent. Flies exposed to the DDT at the higher temperatures showed slightly greater mortality, apparently because of the longer time required for knock-down and consequent longer contact with the DDT. In an experiment in which flies were exposed at 65°F. in a box treated 87 days previously with 50 mg. DDT per sq. ft., transferred to a chamber at 70°F. when knock-down was complete (after 63 minutes), and removed after various intervals to another chamber at 100°F., recovery of flies after removal from 70°F. was progressively less and mortality was greater, the longer the flies had remained at this temperature. Some flies recovered at 100°F. after being completely inactive for several hours at 70°.

When flies were exposed at 70 and 95°F. for 5 or 10 minutes (not long enough to cause knock-down) in gauze cages treated 25 days previously with DDT and then kept at 70, 80, 90 or 100°F. for 24 hours, very little difference in mortality occurred between flies exposed at the two temperatures. However, the flies always showed a higher knock-down and mortality at the lower post-exposure temperatures, irrespective of the exposure temperatures. Flies exposed until all were knocked down in cages treated several days previously with pyrethrum spray at 200 mg. pyrethrins per sq. ft. and then transferred to clean cages at different constant temperatures were knocked down faster at 95°F. than at 70, and more recovered when they were kept at the lower temperatures. Furthermore, greater mortality occurred after 24 hours when

exposure was made at 95° than at 70°, irrespective of the subsequent temperature. In all respects, these results are the reverse of those obtained with DDT. Pyrethrum gave no knock-down after about ten days.

The results obtained indicate that temperature may influence the effectiveness of DDT against a given species of insect in various parts of the world. However, deposits of DDT are effective against house-flies over a wide range of temperatures.

MADDEN (A. H.), LINDQUIST (A. W.) & KNIPLING (E. F.). **DDT and other Insecticides as residual-type Treatments to kill Bedbugs.**—*J. econ. Ent.* **38** no. 2 pp. 265–271, 3 refs. Menasha, Wis., 1945.

Most of the results of these investigations, undertaken to find a material for the control of *Cimex* spp. that would retain its toxic properties for a considerable time after its application, have been noticed [*R.A.E.*, B **32** 197]. In addition to a fuller account of the tests already dealt with, this paper includes data on a preliminary cage test, further results of tests in progress, and a little additional work on DDT and its analogues. Of four analogues tested at 5 per cent. in refined kerosene (Deobase), the best was 2,2-di-para-anisyl-1,1,1-trichlorethane, which gave complete mortality after 28 days and a very high mortality after up to 39 days and is considered worthy of further study. In a test made in cages to compare the duration of toxicity of the residue of DDT sprays applied at various dosages and in different forms, an aqueous emulsion containing 5 per cent. DDT prepared from a concentrate of 25 per cent. DDT, 25 per cent. Wetsit (alkylated aromatic sulphonate) and 50 per cent. xylene, applied at 150 mg. DDT per sq. ft., gave complete mortality after 191 days, the next most effective treatments being 5 per cent. DDT in kerosene at 100 mg. DDT per sq. ft. and 10 per cent. DDT and 10 per cent. cyclohexanone in Deobase at 150 mg. DDT per sq. ft., both of which gave complete kill after 171 days. The last solution applied at 100 mg. per sq. ft. gave complete kill after 136 days. Mortality fluctuated between 80 and 100 per cent., but the latter was recorded more frequently. A number of tests showed that DDT applied as an aerosol leaves a durable and effective toxic residue. In one test, 6·5 per cent. DDT, 12·5 per cent. orthodichlorbenzene and 2·5 per cent. oleic acid with methyl chloride as the propellent gas applied at 100 mg. DDT per sq. ft., gave complete kill after 54 days and 60 per cent. kill after 129 days. In practical tests carried out in infested houses and army barracks in Florida [*cf. loc. cit.*], original infestations were eliminated, and sprays containing 5–20 per cent. DDT are now stated to have remained highly effective for 5–11 months.

GINSBURG (J. M.). **Toxicity of DDT to Fish.**—*J. econ. Ent.* **38** no. 2 pp. 274–275, 1 ref. Menasha, Wis., 1945.

The following is substantially the author's summary. Observations in the course of field experiments in New Jersey with mosquito larvicides containing DDT indicated that this chemical was toxic to three kinds of fish. Laboratory experiments with various concentrations of DDT applied in a water-miscible solvent, as an oil emulsion and as a dust showed it to be highly toxic to goldfish, the toxicity of the three preparations being in the order named.

SCHROEDER (H. O.), MADDEN (A. H.), WILSON (H. G.) & LINDQUIST (A. W.). **Residual Action of DDT Aerosols against Houseflies.**—*J. econ. Ent.* **38** no. 2 pp. 277–278, 2 refs. Menasha, Wis., 1945.

In preliminary tests in March 1943, very good results were obtained when an aerosol of 20 per cent. DDT in methyl chloride was directed over and under

the bedsprings and mattresses and on walls and baseboards in houses in Florida heavily infested with bedbugs [*Cimex*]. The toxicity to house-flies [*Musca domestica*, L.] of deposits from aerosols containing DDT in Freon-12 [dichlordifluoromethane] was therefore tested. Aerosols containing 2·5 and 5 per cent. DDT with 10 per cent. cyclohexanone and 0·2 per cent. pyrethrins in Freon-12 and, for comparison, one containing 0·4 per cent. pyrethrins and 8 per cent. sesame oil were released from time to time at the rate of 3 gm. aerosol per treatment into the centre of rooms of 700 cu. ft. capacity, and at various intervals after treatment house-flies were exposed in the rooms for 24 hours. Mortality was 97 per cent. or more up to ten days after only one treatment with the aerosol containing 5 per cent. DDT. Over the same period, mortality in the rooms treated with the pyrethrum aerosol and untreated was 17 per cent. or less. The mortality obtained with the 2·5 per cent. DDT was erratic. The data obtained appeared to indicate that an effective residue against flies can be built up by the continued use of DDT aerosols, although most of the small particles settle on the floor and they do not adhere well to vertical or overhead surfaces, whereas sprays with large-sized particles deposit a good residue on such surfaces. The results of box tests, in which 1 gm. aerosol was released at each treatment in boxes of 100 cu. ft. capacity, confirmed those of the room tests. The 5 per cent. DDT aerosol was used and also one in which the concentration of DDT was reduced to 3 per cent. and lubricating oil was substituted for half of the cyclohexanone ; the latter gave better immediate results, but the two were equally effective after six applications. It is concluded that although the purpose of DDT aerosols is primarily to kill flying insects quickly by contact, their continued use will leave a deposit that will be a valuable adjunct in control. If, however, it is desired to obtain control principally by the action of the residue, sprays with large droplets should be applied.

Use of DDT for Mosquito Control in the United States. (A joint Statement of Policy by the U.S. Army and the U.S. Public Health Service.)—*J. econ. Ent.* **38** no. 2 p. 284. Menasha, Wis., 1945.

It has been decided to restrict the employment of DDT for mosquito control outdoors in the United States until the effect of its extensive dissemination on beneficial insects and other animal and plant life has been ascertained. It will be used for spraying the interior of buildings to obtain a toxic residue to kill mosquitos before they have the opportunity of transmitting malaria, but its application as a mosquito larvicide will be limited to experimental investigations and to situations where it has definite advantage over other larvicides and presents no hazard to fish or other wild life. Its distribution from aircraft for area control of mosquitos will be limited to operations carried out with due regard to its possible effects on plant and animal life and in accordance with safeguards established by the Public Health Service and the Surgeons General of the Army.

PAPERS NOTICED BY TITLE ONLY.

WOMERSLEY (H.). **Acarina of Australia and New Guinea. The Family Leeuwenhoekiidae.**—*Trans. roy. Soc. S. Aust.* **69** pt. 1 pp. 96–113, 9 figs. Adelaide, 1945.

POWNING (R. F.). **The Analysis of D.D.T. and Pyrethrins in Kerosene-based Sprays** [containing both].—*J. Coun. sci. industr. Res. Aust.* **18** no. 2 pp. 121–123, 3 refs. Melbourne, 1945.

Wickware (A. B.). **Grasshoppers. A potential Danger to Turkeys.**—*Canad. J. comp. Med.* **9** no. 3 pp. 80–81, 3 refs. Gardenvale, Quebec, 1945.

Examination of a turkey hen received in a moribund condition from a farm in the Ottawa district on which six hitherto healthy turkeys had died during the previous night showed that it was well nourished and free from structural defects or parasites but the crop was filled with grasshoppers. H. L. Seamans identified the grasshoppers as *Melanoplus femur-rubrum*, Deg., and *M. mexicanus*, Sauss., which are common in that part of Canada. He stated that no poisoning of grasshoppers had been carried out to his knowledge in the area during the season and that it is in any case doubtful whether turkeys would die as a result of ingesting arsenical bait in grasshoppers. He concluded that the birds had probably died because of irritation or actual puncturing of the crop by the hard parts of the grasshoppers, particularly the spined legs, since he has observed that Gallinaceous birds are killed in this way in Alberta and Montana when they eat large numbers of grasshoppers, without appreciable quantities of other food, as they do most often in autumn when the insects are sluggish. Non-gallinaceous birds are apparently not affected.

The author states that sudden deaths amongst turkeys approaching marketable age and free from lesions of specific infections are frequent in late autumn, and recommends that, as a precaution, a large quantity of mash should be given in the morning at this time of year. Giving mash again at mid-day and whole grain in the evening would prevent the birds roaming in search of food.

Gear (J.), De Meillon (B.) & Davis (D. H. S.). **Typhus Fever in the Transkei.**—*S. Afr. med. J.* **18** no. 8 pp. 144–148. Cape Town, 1944.

In 1909–10, an outbreak of typhus, with several deaths, was reported in the Kentani District of the Transkei, but the diagnosis was officially questioned. The existence of the disease in the Transkei was first officially notified in 1917, but the condition then found to be typhus had occurred there since 1900 and probably much earlier. Typhus is now endemic, having been notified in every year since 1917, and epidemics occurred in 1917–22 and 1933–35, and a very serious one began in 1941. All the districts are affected, the inland and higher ones more severely than the coast, probably because more clothes are worn and the inhabitants wash less on account of the lower temperature. Conditions are dirty and there are occasional famines. The first two epidemics followed severe droughts, which caused failure of the crops, and the winter of 1943 was very cold and wet, so that the natives tended to remain in their huts wearing extra clothes, and this favoured the spread of lice (*Pediculus humanus*, L.). Rats from one village have recently been found to be infected with murine typhus, but several batches of rats and rat fleas caught in infected kraals have been examined without murine typhus being detected. On the other hand, strains of typhus have been isolated from nine out of ten batches of lice removed from patients or convalescents in ten infected kraals. Both *P. h. humanus* (*P. h. corporis*, Deg.) and *P. h. capitis*, Deg., harboured the infection. It is concluded that although flea-borne murine typhus occurs and South African tick-bite fever is relatively common, the great majority of the infections are louse-borne typhus. Lice were usually not numerous on infected persons, and it seems that, once typhus becomes widespread, the number of lice required to maintain it is not large. An account is given of native customs that favour the spread of infected lice, some of which were found on persons who had been convalescent for as long as two weeks. Head lice were more common on children than on adults.

Data are given on the symptoms, prognosis, diagnosis and treatment of typhus and measures for its control. Preventing movement of the population is not practicable, and attention is chiefly directed to the control of lice. A

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combination of heat treatment of clothing and the application of chemicals to clothing and to the body is considered desirable. To prevent the spread of the disease to other parts of South Africa, it has been suggested that centres at which natives are freed from lice should be set up on the borders. Such centres functioned satisfactorily during the epidemic that occurred in 1917–22. Vaccination is also discussed.

Annual Report for the Year 1944 of the South African Institute of Medical Research, Johannesburg.—47 pp. Johannesburg [1945].

An outbreak of relapsing fever occurred during the year among the troops at Kimberley, and the disease was found to be endemic there. Cases were also numerous at Graaff-Reinet, where the town area and an adjoining village were heavily infested with *Ornithodoros moubata*, Murr., and the infection of the ticks with the spirochaete was demonstrated locally.

In laboratory investigations on the life-cycle of *Liponyssus bacoti*, Hirst [*cf.* *R.A.E.*, B **33** 117, 153], the mites were reared individually on young examples of *Mastomys coucha*. The larvae and deutonymphs both moulted once and did not feed, but the protonymphs moulted twice after 2–4 feeds. The females of two successive generations reproduced parthenogenetically, all the progeny being females, and the scarcity of males in nature suggests that parthenogenesis is the normal means of reproduction.

[Detinova (T. S.).] **Детинова (Т. С.). On the Influence of Glands of internal Secretion upon the Ripening of the Gonads and the imaginal Diapause in** *Anopheles maculipennis*. [*In Russian.*]—*Zool. Zh.* **24** fasc. 5 pp. 291–298, 8 figs., 21 refs. Moscow, 1945. (With a Summary in English.)

It is concluded from the experiments described that the corpora allata in mosquitos of the genus *Anopheles* produce hormones of sexual activity. They are small in newly emerged females of *Anopheles maculipennis*, Mg., but increase in size in a few days, both in sexually active females and those in a state of diapause, whether or not the females have fed. Their reactions to stains, however, indicate that glandular activity occurs only in sexually active females. When a ligature was tied behind the corpora allata of females that had fed just before, the ovaries did not develop; but development took place when it was tied six hours after the intake of blood, indicating that this interval was necessary to allow the hormone to penetrate in sufficient quantity into the ovary.

Chwatt (L. J.). **Studies on the Melanic Variety of** *Anopheles gambiae* **in Southern Nigeria.**—*J. trop. Med. Hyg.* **48** nos. 2–3 pp. 22–30, 51–55, 32 refs. London, 1945.

After an introductory review of the literature, a detailed account is given of breeding experiments made in Nigeria with *Anopheles gambiae*, Giles, and the melanic form *melas*, Theo., which is variously considered a distinct species [*R.A.E.*, B **33** 32] and a variety of it [**33** 160]. The following is based on the author's conclusions. The melanic characters in adults of *Anopheles gambiae* var. *melas* show a very wide range of variation. Intermediate stages between maximum melanism (dark integument, four-banded palps, dark wings, reduced tarsal bands) and typical *A. gambiae* are common. There seems to be no close association between the melanic characters of maternal and filial generations of *A. gambiae* and *A. gambiae* var. *melas* bred in the laboratory. Statistical analysis showed that the probability of direct inheritance of melanic characters (from maternal to filial generation) does not exceed the limits of a chance distribution. Measurements of eggs selected from samples from 173

batches of eggs obtained in the laboratory showed that it was possible to classify the eggs from 91·4 per cent. of the samples into *melas* and type forms. The remaining samples could not be classified as the eggs in each showed a range of variation in the distance between the frill and the float [*cf.* **34** 5]. The distribution of melanic characters in adults of the filial generation shows little evidence of any relationship with development in salt water (14 gm. Cl per 1,000 cc.). There seems to be no close or constant association between the structure of the eggs of a given batch and melanic characters in the adults of the maternal and filial generations. Eggs from batches of which samples differed morphologically showed no apparent difference in their faculty for developing in salt and fresh water.

It appears that *A. gambiae* var. *melas* is a biological race differing from the type mainly in its ecological preferences, physiological adaptation to breeding in salt water and its present geographical distribution. It is suggested that the rank of a variety of *A. gambiae* be provisionally retained for it until knowledge of its morphology, ecology, bionomics and geographical distribution is more complete.

Bradley (G. H.). **Entomological Problems in Malaria Control.**—*J. nat. Malar. Soc.* **4** no. 1 pp. 1–8, 5 refs. Tallahassee, Fla., 1945.

In the course of this presidential address, in which various problems relating to the control of Anophelines that are vectors of malaria are reviewed with particular reference to those needing further investigation, brief preliminary results are given of a study made in Georgia by precipitin tests of the blood-feeding habits of the common Anophelines of the United States. Analysis of early-season records showed that out of 9,000 females of *A. quadrimaculatus*, Say, 1,550 of *A. crucians*, Wied., and 1,300 of *A. punctipennis*, Say, 4·2, 3·9 and 3·0 per cent., respectively, had fed on man. Nearly all these mosquitos were collected in outbuildings or resting places out of doors. Collections from houses would have raised the proportion of *A. quadrimaculatus* containing human blood, as this species frequents dwellings more than the other two, but the results show that *A. crucians* and *A. punctipennis* feed regularly on man.

Hess (A. D.) & Hall (T. F.). **The Relation of Plants to Malaria Control on impounded Waters with a suggested Classification.**—*J. nat. Malar. Soc.* **4** no. 1 pp. 20–46, 2 figs., 23 refs. Tallahassee, Fla., 1945.

As *Anopheles quadrimaculatus*, Say, breeds only in waters where there is abundant vegetation and floatage intersecting the water surface [*cf. R.A.E.*, B **32** 210], studies were made in the Tennessee Valley on the relationship of plants to its control in reservoirs. What was known on the subject in 1940 was reviewed in a previous paper [**30** 161], but data available after a further four years' study are included in the present one. It contains a classification of plants in relation to control of the Anopheline; a list of the more important species of each type in the Tennessee Valley; a graph showing the numbers of larvae produced per square foot (Anopheline potential) among plants of ten different types of importance in relation to malaria control; and sections on plants among which breeding does not occur, on the relation of microscopic plants to Anopheline production [*cf.* **20** 174], and on the relation of plant types to reservoir preparation [*cf.* **30** 161], water-level management [**33** 122], shoreline maintenance and the application of larvicides.

The following is based on the authors' summary. The factors that govern the importance of various types of plants in relation to malaria control are those that influence the economy and effectiveness of operations directed against the Anopheline vectors, so that the relative importance of a given type is not determined solely by its Anopheline potential, but also by the extent to

which it can spread into the water (colonisation potential) and the difficulty and expense involved in controlling it or the mosquito breeding associated with it. The importance of the ten plant types into which the vegetation of the Tennessee reservoirs is divided has been evaluated, and the results for nine are tabulated. The floating-leaved type is considered the most important, although it has the lowest production potential [*cf.* **33** 122], because some plants of this type have very high colonisation potentials and may enable Anophelines to breed in deep water. Under normal schedules of water-level management, the marginal band of vegetation is usually restricted to the upper foot or two of contour, but lotus (*Nelumbo pentapetala*) commonly grows in water 8 ft. deep, and may change vast areas of open water into favourable breeding grounds, thus tremendously increasing the total number of *A. quadrimaculatus* that a reservoir can produce. Moreover, water-level management does not control Anopheline breeding among vegetation of the floating-leaved type, and costly plant control or permanent shoreline improvement is necessary. The floating-mat type is second in importance because of its lower colonisation potential. The species of this type in the Tennessee Valley become rooted only in shallow water near the shore and the extent to which they can increase the breeding area over deep water is limited to one season's growth. The water hyacinth (*Eichhornia crassipes*) forms unattached floating mats that may develop independently of the shoreline and so has a very high colonisation potential and might be of more importance than the floating-leaved type, but though it has been found in the reservoir areas in the Tennessee Valley, it is not believed to survive the average winter there.

Water-tolerant coppice is third in importance. It has a high colonisation potential, but Anopheline production in it may be controlled fairly well by cyclical fluctuation and the coppice can largely be brought under control by suitable shoreline maintenance and water-level management [*cf.* **30** 161]. The flexuous type and the erect leafy type are fourth and fifth, respectively. The former has a higher Anopheline potential than the latter, and control in it by water-level management is more difficult. The erect naked type is sixth. It has a low Anopheline potential, but some species have rather high colonisation potentials in the zone of fluctuation and may require the application of special growth-control measures. Although the submerged aquatic type has one of the highest Anopheline potentials, it is placed seventh, chiefly because its inability to survive out of water greatly limits its colonisation potential under normal schedules of water-level management. It may be of greater importance on reservoirs where the seasonal recession of water level is less than three feet. The carpet type, which is eighth, has a high Anopheline potential, but colonises only limited areas and provides a very narrow band where breeding may occur because it does not grow tall. It and the preceding type are of no importance in relation to shoreline maintenance. The last type, pleuston (minute plants floating free at the water surface), is of no local importance because normal water-level management limits it to small areas where water levels are maintained by springs or seepage, and, even in these areas, it has a very low Anopheline potential.

It is pointed out that the relative importance of the different types in the reservoirs of the Tennessee Valley Authority changes from time to time as a result of control measures.

Mulrennan (J. A.), Goodwin (M.) & Shannon (R. C.). **The Importation of exotic Anophelines into the United States.**—*J. nat. Malar. Soc.* **4** no. 1 pp. 56–58, 2 refs. Tallahassee, Fla., 1945.

A dead female of *Anopheles* (*Nyssorhynchus*) sp. was found under a bridge about a mile from the runways on an air base in Florida in August 1943, but careful investigation of the entire area failed to reveal any further tropical

Anophelines. A fourth-instar larva of *A.* (*N.*) *albimanus*, Wied., was collected on 10th May 1944 in a canal on another airfield in Florida, but extensive searches revealed no other larvae or adults. An aeroplane had arrived at this airfield from Porto Rico on 1st May and there was no record of its having been fumigated. It is suggested that a female of *A. albimanus* was brought from Porto Rico in it and oviposited at the airfield. *A. albimanus* had not previously been recorded in Florida since 1904. A list is given of the dead Anophelines collected from aircraft arriving at Miami from foreign ports between 1st January and 1st October 1944. They comprised 29 individuals belonging to five species and seven that were not identified.

Vorhies (C. T.) & Wehrle (L. P.). **Preliminary Tests of DDT Applications to Crop Plants and Livestock with Navy's Fog Generator.**—*Mimeogr. Rep. Ariz. agric. Exp. Sta.* no. 75, 13 pp. [Tucson, Ariz.] 1945.

The authors describe experiments carried out in Arizona in 1945 to determine whether a fog-generating apparatus used by the United States Navy to produce a "smoke screen" could be used for the application of insecticides (chiefly DDT in oil) to plants [*R.A.E.*, A **34** 262] and livestock.

In tests on livestock, an enclosed chute was filled with cattle and a fog consisting of a 2·4 per cent. solution of DDT in a 9 : 1 mixture of kerosene and oil with a viscosity of 60 was applied for 1½ minutes, after which the chute was emptied and the treatment was repeated on another lot of animals. A larger herd was treated with the fog in a partly closed barn from two points of application, for 1½ minutes from each, and a barn without cattle was treated for 2½ minutes. Flies on the cattle died in a short time, and animals with an estimated infestation of 400–500 flies each were free from them after treatment and largely free two days later; they showed no discomfort during treatment or ill effects after it. The DDT deposited on the woodwork of the barns killed flies during the second night after treatment. In further tests, yearling steers on pasture, heavily infested by horn flies [*Siphona irritans*, L.] and more lightly by stable flies [*Stomoxys calcitrans*, L.] were kept by horsemen in loose bunches of 120 and 187 on open spots in the pasture while the fog generator was driven slowly round them for 8–10 minutes so that all were wetted by a fog of 5 per cent. DDT in kerosene and oil (9 : 1). Examinations showed estimated infestations of 2–3 flies per animal after one day and about 5–10 per animal after one and two weeks. The approximate cost per animal was four cents.

McCulloch (R. N.). **Notes on the Habits and Distribution of Trombiculid Mites in Queensland and New Guinea.**—*Med. J. Aust.* 1944 **2** pp. 543–545. Sydney, 1944.

The habits of Trombiculid larvae are briefly described. The technique used for collecting them in this study consisted of standing still in situations likely to harbour mites and taking them from the boots by means of a camel-hair brush moistened with alcohol. Impregnating the clothing with a suitable acaricide gave protection from mites that crawled above the boots. *Trombicula minor*, Berl., is very numerous in parts of the Atherton Tableland and is apparently almost the exclusive cause of "scrub itch" in northern Queensland [*cf. R.A.E.*, B **28** 146]. Scrub typhus (tsutsugamushi disease) occurred among the troops on the tableland, but the number of cases was very low compared with the incidence of itch, and infection was traced to a few small and fairly well defined areas. In one of these, odd individuals of *Acomatacarus* (*Leeuwenhoekia*) *hirsti*, Wom., and *Neoschöngastia melomys*, Wom., were found among a heavy population of *T. minor*. It is popularly believed that scrub itch is

acquired in the tropical rain forests (scrub) and is particularly associated with rotting logs. In these investigations, however, mites were rarely found in dense scrub or on cleared grass land, and rotting logs appeared to be of no importance. Typical habitats were a belt a few yards wide along the edge of the scrub, tracks or small clearings in the scrub where grass grew weakly or not at all, and the ground under trees or bushes in open savannah or cleared scrub land, where the shade was sufficient to interfere with grass growth. When stimulated by the presence of a prospective host, the mites leave the soil and climb grass and twigs to a height of about three inches. In autumn and early winter, they were most active on warm, dry days. They were very active at a shade temperature on the grass of 67–75°F., less so at 65° and almost inactive at 60°. Mites in tubes were motionless at 50°F. but recovered full activity when warmed to 70°. If the temperature was suitable, activity was as great by night as by day.

Mites crawling on the skin are not felt, except on the face, ears and scalp. Itching usually begins 10–18 hours after attachment, and the mite may be seen in the middle of a raised red area. If not scratched, the lump usually ceases to itch in 4–5 days. Many hundreds of bites cause intense irritation. Scratching usually removes the mite with a piece of skin and often leads to secondary infection. Removal of the mites by needle three or four hours after attachment does not prevent the development of an irritant spot. Rats infested by hundreds of mites in various stages of engorgement remain apparently unaffected.

In some areas of New Guinea, there was scrub typhus without recorded itch and in others a great deal of itch and little typhus, as at Atherton. At Donadabu (some 20 miles from Port Moresby), which has a history of typhus infection, the predominant species in the very light population of mites were identified as *T. fletcheri*, Wom. & Heas., and *T. walchi*, Wom. & Heas. [which have since been found to be conspecific with *T. akamushi*, Brumpt, and *T. deliensis*, Walch, respectively (see next paper)]. There were occasional individuals of the genera *Schöngastia*, *Neoschöngastia* and *Guntherana*. At Dobadura, near Buna, where much itch and some typhus occurred, about 80 per cent. of 400–500 mites collected from man were *S. pusilla*, Wom., 15 per cent. *S. blestowei*, Gunther, and the remainder *T. minor*. The genera *Neoschöngastia*, *Guntherana* and *Acomatacarus* (*Leeuwenhoekia*, *sens. lat.*) were represented among other mites collected in the area and also several species of *Trombicula*, including *T. akamushi* (*fletcheri*) and *T. deliensis* (*walchi*). These two were the most numerous species at Buna, where there was typhus but little or no itch, and only the former and a species of the *T. minor* group were found at Nadzab in the lower Markham Valley, where there had been some typhus. So far, therefore, observations in New Guinea seem to indicate that *T. akamushi* (*fletcheri*) and *T. deliensis* (*walchi*) are the vectors of scrub typhus there. However, at Dumpu in the Ramu Valley, *S. blestowei* alone was more clearly indicated as the vector (as well as the cause of itch) than any other single species elsewhere. It was found almost everywhere in the grass country of the valley, nearly always without another species, and was the only species found after most careful searching in several camps with a history of typhus. It was rare in patches of jungle.

In New Guinea, there was no clearly defined mite belt along the scrub edges as there was at Atherton. In observations at Dobadura, which can be taken to apply to *S. pusilla*, mites were much more active after rain than during it or on the rare occasions when the ground was dry. When stimulated by the presence of human bodies, they moved freely about the surface litter, but rarely climbed more than three inches. Mites kept in the shade in tubes at daily minimum and maximum temperatures of about 75 and 88°F. were usually dead in 4–6 hours, but with added damp blotting paper they survived for 2–3 days. In more recent experiments at Lae, *S. blestowei* collected on boots and transferred to moist soil in test tubes survived for 46 days. This and several other species of *Schöngastia* and *Paraschöngastia* examined in the field were as active by night as by day. It appears that a person walking on infested

ground would be bitten little or not at all, but to stand, sit or lie on it at night or in the day would probably result in attack. Grass cut and dried for bedding probably carries no mites. Cutting and burning kunai grass about tents and buildings and keeping it cut may reduce numbers of mites though it does not eradicate them, but mites quickly disappear from paths and trampled ground and from the floors of tents and buildings.

McCulloch (R. N.). **Studies in the Control of Scrub Typhus.**—*Med. J. Aust.* 1946 **1** no. 21 pp. 717–738, 14 figs., 23 refs. Sydney, 1946.

An examination of the application of phthalates against Trombiculid larvae with a view primarily to controlling scrub typhus [tsutsugamushi disease] among troops in forward fighting areas, was begun in Australia in March 1943 and continued in New Guinea and Borneo. In tests in Australia in which men wearing treated or untreated clothes lay or sat for a time each day in areas previously shown to be heavily infested with *Acomatacarus australiensis*, Hirst, *Trombicula samboni*, Wom., or *T. minor*, Berl., dimethyl and dibutyl phthalate were both very effective, but dibutyl phthalate, which was much the more readily available in Australia, retained its effectiveness after the clothes were rinsed in cold water, whereas dimethyl phthalate did not. The treatment was more effective when applied evenly over the clothes than when applied in a band round the edges. In tests in New Guinea later in the year, dibutyl phthalate at 1 fl. oz. per set of clothes (corresponding to 1·4 ml. per sq. ft. of material) gave complete protection until exposure ended after 22 days, the clothes having then been washed in cold water eight times. Dimethyl phthalate at the same dosage and DDT used both as a powder at 7·5 gm. and as a solution in oil at 5 gm. gave less lasting protections, ceasing to be effective after the clothes had been washed 2–4 times.

An account is given of the development of a technique for testing the toxicity to mites of treated cloth. By the technique adopted, studies were made in the case of cloth treated with dibutyl phthalate of the effect of the method and rate of application and different methods of washing, and of the relative susceptibility of different species of mites, and evidence was obtained that the efficiency of the treatment was not affected by sweat, storage of cloth, the form of dibutyl phthalate (normal or secondary), the method of drying washed cloth, the kind of cotton cloth, newness, water-proofing or wetness of cloth, or application to the inside rather than the outside of garments, but was reduced if the cloth was wetted at the time that the mites were exposed to it. Attempts to increase resistance to washing were unsuccessful, but it was high unless the cloth was boiled. Wool washed as cotton with vigorous rubbing lost toxicity sooner than cotton, but wool that was only squeezed retained the dibutyl phthalate as long as vigorously rubbed cotton. Dimethyl phthalate was much more rapidly toxic to mites than dibutyl phthalate on unwashed cloth, but it lost its toxicity after one wash. Staway [*cf. R.A.E.*, B **29** 65] and Rutgers 612 [2-ethyl-1,3-hexanediol] appeared likely to give protection from mites if applied after each wash to clothes washed every day or two. The method adopted for use by Australian troops was complete treatment of socks, trousers and shirt every two weeks with one fl. oz. dibutyl phthalate rubbed in by hand, with no restriction on cold-water washing. Detailed instructions on the method to be used are given in an appendix. Dipping and spraying as alternatives to hand application are discussed. Blankets were treated when supplies made it possible. The additional protection was not evaluated, but as treatment every six months would certainly keep blankets mite-proof, it is considered that the additional outlay in material and labour would be well worth while. Dibutyl phthalate does not appear to irritate the skin, but one accident showed that a small quantity in the eye can cause

serious injury. The best practicable protection against bites on the head is considered to be routine and thorough use of dimethyl phthalate as a mosquito repellent.

The results of the use of dibutyl phthalate by troops in action were studied in various areas. Control of scrub itch was excellent, and it is considered that the treatment was shown to be capable of giving practically complete freedom from scrub typhus. Routine use of dibutyl phthalate by Australian troops was followed by a reduction in scrub typhus of more than 90 per cent. in the New Guinea area, and a more detailed study of the Ramu Valley showed an even closer correlation between the efficient use of dibutyl phthalate and the decline in the case rate. J. Gunther reports that a research unit of 12 men lived on South Bat Island [*cf.* **34** 147] for 119 days from July to November 1945 without becoming infected. They camped on the site occupied by the combined force that was attacked by scrub typhus in 1944, explored the island and recovered strains of *Rickettsia* from mites on rats. The earth of tent floors and immediate surroundings was sterilised with creosote, but, apart from this, protection depended on the wearing of long leather boots impregnated with dimethyl phthalate and the treatment of clothing by dipping in 5 per cent. emulsion of dimethyl phthalate for the first week and of dibutyl phthalate once a fortnight subsequently. The possibility of controlling scrub typhus by avoiding infested areas or by clearing localities of mites by such measures as removal of vegetation and surface soil or spraying with sodium dinitro-ortho-cresylate in solution is discussed; in experiments, the spray reduced the numbers of mites, but did not eliminate them.

The paper concludes with some observations on the habits of Trombiculid larvae, supplementary to those made in the previous one, and also notes on individual species of mites. There was a great difference in the species distribution as indicated by collections from animals and from boots. Some 45 species were taken, of which about 12 are undescribed. *T. samboni* was extremely abundant in South Australia and was reported to attack horses, cattle and sheep as well as rabbits. None of the few infested sheep examined seemed seriously harmed by clusters of mites on the lower parts of the legs. A species tentatively identified as *T. wichmanni*, Oudm., was the only mite taken in numbers on boots in Borneo and the only one found in the country near Balikpapan where scrub typhus existed. Womersley informed the author in 1945 that he considers *T. deliensis*, Walch, and *T. akamushi*, Brumpt, to include *T. walchi*, Wom. & Heas., and *T. fletcheri*, Wom. & Heas., respectively [*cf.* preceding abstract]. Both were taken in nearly all areas visited by the author in New Guinea; they were sometimes numerous on individual rats, but were always scarce in boot collections. Knowledge of their reaction to phthalates on cloth is limited, but the apparently successful control of scrub typhus by dibutyl phthalate in New Guinea indicates that the vector mites are as susceptible as the itch-causing forms.

Blake (F. G.), Maxcy (K. F.), Sadusk jr. (J. F.), Kohls (G. M.) & Bell (E. J.). **Studies on Tsutsugamushi Disease (Scrub Typhus, Mite-borne Typhus) in New Guinea and adjacent Islands: Epidemiology, clinical Observations, and Etiology in the Dobadura Area.**—*Amer. J. Hyg.* **41** no. 3 pp. 243–373, 3 col. pls., 32 figs., 152 refs. Lancaster, Pa., 1945.

In addition to a detailed review of the literature on tsutsugamushi disease in the Japanese Empire and elsewhere, from which it is concluded that this disease (caused by *Rickettsia orientalis*) occurs with some variation in clinical manifestations and has been recorded under other names in many parts of south-eastern Asia, adjacent islands of the Indian Ocean and south-western Pacific, and northern Queensland [*cf. R.A.E.*, B **32** 161, etc.], this paper contains

accounts of investigations on its clinical characteristics, pathology, epidemiology and etiology as it occurs in New Guinea and neighbouring islands, made in the Dobadura area in 1943 and subsequently in a laboratory in the United States.

The following is based on the authors' discussion of the studies on epidemiology and their summaries of the sections on etiology. The epidemiological features of the disease commonly called scrub typhus among the military forces operating in Papua, New Guinea, were similar to those described for tsutsugamushi disease in Japan, Malaya, Sumatra, northern Queensland and other endemic areas. An analysis of the occurrence of cases among American forces in an advanced base area near Buna on the north-eastern coast of New Guinea indicated that, while the disease was contracted in widely scattered localities, some places were more dangerous than others. The environments in which infections were known to have originated in the period of study in the Dobadura area were kunai grass fields in which natural conditions were undisturbed at the time of occupation. Infections were most likely to occur during the first week or two after arrival in a new area and became sporadic or ceased after the fourth or fifth week. As the decline could not be explained by an accumulation of immune individuals, it was probably due to a decrease in exposure to the Trombiculids that served as vectors, correlated with progressive changes produced by the development and use of the camp site.

Collections of mite larvae were made in localities where cases had originated and extensive environmental changes had taken place, and also in similar localities where natural conditions had not been disturbed. Larvae were taken from boots [*cf.* **34** 141] and from small mammals (particularly rats of at least six species of three genera and the bandicoot, *Echymipera cockerelli*). Three of the species taken, *Trombicula buloloënsis*, Gunther, *Schöngastia blestowei*, Gunther, and *S. pusilla*, Wom., were known to attack man and produce scrub itch. They were abundant and widely distributed, but seemed unlikely vectors of tsutsugamushi disease as they continued to be present in considerable numbers in infected localities after cases had become sporadic or ceased to occur, and two of them were found only infrequently and in small numbers on bandicoots and rats, while the third (*S. pusilla*) was not taken on these hosts at all. Moreover, there was no correlation between the incidence of scrub itch and that of the disease, patients gave no history of itching at the site of the eschars, and the latter were found on various parts of the body, whereas the lesions of scrub itch were characteristically distributed on the ankles, legs and lower trunk. Ten of the remaining species were either rare or absent in boot-collections or were not found on rats or bandicoots. The others, which are closely related and are deemed to merit special consideration, were identified as *T. deliensis*, Walch, *T. walchi*, Wom. & Heas., and *T. fletcheri*, Wom. & Heas., [but according to Womersley's recent opinion (see preceding abstract), comprise only two species, *T. deliensis* (*walchi*) and *T. akamushi*, Brumpt (*fletcheri*)]. Those identified as *T. deliensis* were found only in one restricted locality, in which, however, the incidence of the disease was high. They were not represented in boot-collections and were found only on three of 55 rats examined. Those identified as *T. walchi* occurred sparingly, but *T. akamushi* (*fletcheri*) far exceeded in frequency and numbers all other species on rats and bandicoots. Collection of unfed larvae in the type of environment associated with the risk of infection and in certain known infected localities showed that troops were exposed to attack by both species. In one infected locality in which mites were scarce, these were the most numerous species in boot-collections and no scrub-itch mites were found. The observations made are consistent with the hypothesis that either or both of these species may be vectors in this area. Two strains of rickettsiae were recovered by inoculation into mice from two pools of mites collected from two bandicoots. All and almost all the mites in samples from the two pools were *T. akamushi* (*fletcheri*). Brain tissue from these and other bandicoots injected into white mice failed to produce a rickettsial

infection. In view of this negative result and the fact that generation-to-generation transfer of *R. orientalis* occurs in mites, the bandicoot is not incriminated as a reservoir. There was no evidence to suggest that Arthropods other than Trombiculid mites were involved in transmission.

Nine strains of rickettsiae isolated from the blood of patients thought from clinical examination to have tsutsugamushi disease were carried through 5–12 serial passages in white mice. The rickettsiae were apparently identical with *Rickettsia orientalis*, and the characteristics of the infection in mice were those of tsutsugamushi disease. Rabbits were infected by intraocular inoculation with six of the strains, and the ocular reaction was identical with that caused by *R. orientalis*. The results of Weil-Felix agglutination tests with Proteus OXK on the sera from nine rabbits that had manifested typical ocular reactions were negative. The Syrian hamster [*Cricetus auratus*] was shown to be susceptible to intraperitoneal inoculation of the strains, one of which was carried through more than 15 serial passages. Five of the strains were cultured in the yolk-sac membrane of the developing chick embryo, and suspensions of the cultures invariably produced a typical infection and death when inoculated intraperitoneally into mice and typical ocular reactions in rabbits. Rickettsiae were demonstrated in smears of these yolk-sac cultures stained by Giemsa's method.

Similar studies, including also the reaction in guineapigs, were carried out with the two strains isolated in white mice from the mites collected from bandicoots. The strains were maintained in serial passage for over 20 generations. The results indicated that the morphological and pathogenic characteristics of the strains from mites and man were identical and similar to those described for *R. orientalis*. They confirm the view that the mite-borne or scrub typhus of New Guinea is tsutsugamushi disease.

The results of cross-immunity experiments with rabbits, hamsters and white mice demonstrate a close immunological relationship between the two mite strains and also between each of the mite strains and one of the human strains.

Kohls (G. M.), Armbrust (C. A.), Irons (E. N.) & Philip (C. B.). **Studies on Tsutsugamushi Disease (Scrub Typhus, Mite-borne Typhus) in New Guinea and adjacent Islands : further Observations on Epidemiology and Etiology.** —*Amer. J. Hyg.* **41** no. 3 pp. 374–396, 14 refs. Lancaster, Pa., 1945.

Further observations made in New Guinea have indicated that the connection between kunai grass and tsutsugamushi disease [see preceding paper] has been overemphasised. It is pointed out that infection may be acquired in the south-western Pacific region wherever man is attacked by rat-infesting Trombiculids and that rats of various species are found everywhere. Foci of infection have so far been found by forces in New Guinea and adjacent islands in restricted, open, grassy terrain with kunai grass usually dominant ; in abandoned native gardens, banana and coconut groves ; in sparse, coarse growths of native vegetation overlying coralline ridges and breaks in the interior of certain islands ; and possibly in restricted areas in the edges of virgin, climax rain forest. The first type was of chief concern in British New Guinea and neighbouring islands. The second occurred in small islands and on certain beaches in Netherlands New Guinea, and the third produced a moderate number of cases on two adjacent islands. Most of the cases in American troops were contracted not far above sea-level and in coastal areas. The virulence of the disease varied from one focus to another. The varied environments in which infection was found emphasise the need for taking suitable precautions in any area.

The different epidemiological features of five foci and the mites and their hosts in each are discussed. Further collecting in area A (the Dobadura area) [*cf.* preceding abstract] increased the number of Trombiculids known there to about 30. This was the only one of the five areas in which *T. akamushi*,

Brumpt (*fletcheri*, Wom. & Heas.) and *T. deliensis*, Walch (*walchi*, Wom. & Heas.) were both found. *T. akamushi* comprised about 65 per cent. of all mites in 152 identified collections from rats and 72 per cent. of all mites in 40 collections from bandicoots (*Echymipera cockerelli*), and heavy infestation of a quail suggested that kunai-dwelling birds may also be important hosts of this species, which was associated with grassy areas rather than jungle. It was also found on rats, etc., in areas B and D, which comprised islands near British and Netherlands New Guinea, respectively. *T. deliensis* was found in small numbers on rats and bandicoots in the Dobadura area but was numerous on rats in area C [South Bat Island (see next abstract)] and area E (in Netherlands New Guinea). Cases with and without eschars occurred in the same locality, so the differentiation of " tsutsugamushi disease " and " scrub typhus " on this basis is unwarranted. A number of cases with multiple eschars in Netherlands New Guinea suggests a high incidence of infected mites in a localised area. The distances travelled by Trombiculid larvae in five minutes ranged from 11 to 32 inches on a board and from 2 to 15 inches on different kinds of cloth. Their activity on the soil surface declined during dry weather, when it is believed that they retreat deeper into the soil.

An additional strain of *Rickettsia orientalis* was recovered from a pool of mites consisting chiefly of *T. akamushi* taken from a rat in the Dobadura area and three strains from *T. deliensis* (*walchi*) in area C [see next abstract]. Laboratory tests with twelve bandicoots (eight *Echymipera cockerelli* from New Guinea and four *Isoodon torosus* from a non-endemic area in Queensland) failed to give evidence of the susceptibility of these animals, but two strains of *R. orientalis* were isolated from the brains of *Mus* (*Rattus*) *concolor browni* from the Dobadura area. Laboratory studies of these rat strains in white mice, white rats, guineapigs and rabbits showed them to be identical with strains from man so far as this is feasible in a field laboratory. It is considered that rats are the chief reservoir of tsutsugamushi disease in New Guinea and adjacent islands, that bandicoots are probably important only as hosts of the mites, and that man is completely unimportant as a means of spreading the disease. The danger of mites transferring from dying rats to man is discussed, but is not considered great. Attempts to induce them to transfer from dead to living hosts failed.

Control measures can be designed to reduce mite populations or to give personal protection. For the latter purpose, R. N. McCulloch has developed a system of protection by hand application of fluid to clothing [*R.A.E.*, B **34** 143], and R. C. Bushland has devised a method in which clothing is impregnated with an emulsion of 5 per cent. dimethyl phthalate in 2 per cent. soap solution. Both have been shown to reduce the incidence of the disease.

PHILIP (C. B.) & KOHLS (G. M.). **Studies on Tsutsugamushi Disease (Scrub Typhus, Mite-borne Typhus) in New Guinea and adjacent Islands. Tsutsugamushi Disease with high Endemicity on a small South Sea Island.**—*Amer. J. Hyg.* **42** no. 2 pp. 195–203, 4 figs., 1 ref. Lancaster, Pa., 1945.

South Bat Island, in the Purdy Group, was occupied by less than 50 troops for about six weeks in March and April 1944 and was then abandoned because 26 of the men had contracted tsutsugamushi disease. Two of the cases were fatal. The clinical diagnosis was corroborated by the agglutination of Proteus OXK antigen by some late convalescent sera.

The island, which is essentially uninhabited and has an area of 46 acres, was visited for five days in June by a party of seven, including the authors. It is very low-lying and has a uniform canopy of mature coconut palms, sparse grass and other low-growing vegetation beneath, and a dense growth of scrub along the beach. The only native mammals found were a bat and *Mus* (*Rattus*)

concolor browni, which was extremely abundant. There were also some introduced pigs and some birds. The Trombiculid mites taken were *Trombicula deliensis*, Walch, of which *T. walchi*, Wom. & Heas., is considered a synonym [*R.A.E.*, B **34** 144], *Schöngastia pusilla*, Wom., and a few individuals of an apparently undescribed species of *Neoschöngastia*. *T. deliensis* was abundant on rats and was also taken on a bird and in small numbers in boot-collections among grass in shaded areas. *S. pusilla* was more abundant in boot-collections but was not found on mammals or birds. It was probably responsible for scrub itch reported among earlier occupying forces.

Six pools of mites taken from rats were injected into white mice, and strains of rickettsiae were recovered from the only three providing valid tests. So far as could be ascertained, all the mites were *T. deliensis*. The strains were maintained in serial passage and were highly virulent in mice and guineapigs. Stained smears of peritoneal exudates showed bodies characteristic of *Rickettsia orientalis* and one strain gave the characteristic ocular reaction in a healthy rabbit. This was the first demonstration of the natural occurrence of the agent of tsutsugamushi disease in *T. deliensis*, and the findings suggest that the rate of endemicity in this mite is high on the island.

HUFFAKER (C. B.), SOTO (H.) & REY (H.). **Additional wild-caught *Anopheles punctimacula* D. and K. infected with Malaria Plasmodia in Colombia, South America.**—*Amer. J. Hyg.* **42** no. 2 pp. 107–110, 12 refs. Lancaster, Pa., 1945.

The literature on natural and experimental infection of *Anopheles punctimacula*, D. & K., with malaria parasites is reviewed [*R.A.E.*, B **24** 145 ; **25** 182, etc.], and an account is given of a study in 1944 of natural infection in this species in Colombia. The females collected were supplied with sucrose solution and kept for 5-8 days at 72°F., after which their stomachs were examined for oöcysts. Glands were not examined. No infection was found in 107 females taken in houses in February, but there were oöcysts in varying stages of development in 4 out of 208 taken in houses and one out of 118 taken in stables and animal traps in June. The authors have observed that *A. punctimacula* is attracted to domestic buildings in Colombia and feeds readily on man as well as on pigs kept in or near dwellings. They conclude that it may be a dangerous vector of malaria wherever it is abundant.

DONAYRE (A. C.). **Algunas observaciones entomológicas relacionadas con el paludismo en Lima.** [Some entomological Observations relating to Malaria in Lima.]—*Rev. Med. exp.* **3** no. 3 pp. 244-262, 1 graph, 27 refs. Lima, 1944. (With a Summary in English.)

The results are given of observations made between 1939 and 1943 on malaria morbidity, Anopheline breeding places and populations of adult Anophelines in houses in a military installation on the outskirts of Lima and in two villages in the valleys of rivers in western Peru. *Anopheles pseudopunctipennis*, Theo., was found in large numbers, occasionally accompanied by a few individuals of *A. punctimacula*, D. & K. Dissection of the salivary glands of 1,096 females of *A. pseudopunctipennis* and the guts of 1,121, sometimes several days after capture, showed 12 gland infections and four gut infections. Infection rates in this species recorded from malarious zones by other workers are quoted. The guts and glands of five females of *A. punctimacula* from the military camp were dissected, but no infection was found.

In the districts studied, *A. pseudopunctipennis* bred very near dwellings, chiefly in the pools of clean water that are left between stones near the banks of the rivers when the level of the water falls. These pools were usually in full sunlight, and the surface was practically covered with green algae. Some

breeding also occurred in other pools of clear water containing algae and in slow-flowing irrigation water. Larvae were observed during the first ten months of the year near Lima, and there is every reason to suppose that they occur in November and December also. Larvae of *A. punctimacula* were not found. The adults of *A. pseudopunctipennis* were seldom seen in animal shelters, but were plentiful in houses, where they were most numerous in March and April. There was an increase in the sporozoite index from March to May, owing to the autumnal fall in temperature and increase in atmospheric humidity which prolonged the life of the mosquitos.

WERY (J. E.). **Un cas de gale démodectique du porc.**—*Rec. Trav. Sci. méd. Congo belge* no. 3 pp. 69–70. Léopoldville, 1945.

The carcass of a pig was condemned for human consumption at the slaughter-house at Léopoldville, Belgian Congo, in October 1940 because of the condition of the skin. Microscopic examination showed that it was infested by a species of *Demodex*. The lesions were confined to the parts of the body that touched the ground or that the animal could rub (belly, shoulders and neck). These areas bore numerous pustules near which the hair follicles had been destroyed. Demodectic mange in pigs is apparently of rare occurrence, but it cannot be successfully treated, and pigs that are known or thought to be infested should be slaughtered.

PARENT (M.) & DEMOULIN (M. L.). **La faune anophélienne à Yangambi (INEAC). Biologie *A. moucheti* Evans spécialement. Applications statistiques.**—*Rec. Trav. Sci. méd. Congo belge* no. 3 pp. 159–173, 2 figs., 8 refs. Léopoldville, 1945.

The Anopheline fauna of Yangambi, on the Congo some 60 miles from Stanleyville, was studied for two months in 1938 and six months in 1939–40. Over 38,000 native dwellings were inspected and 21,594 Anophelines found in them. Those identified comprised 4,759 individuals of *Anopheles gambiae*, Giles, 6,716 of *A. moucheti*, Evans, 115 of *A. nili*, Theo., two of *A. obscurus*, Grünb., and one of a fifth species either *A. coustani*, Lav., or *A. paludis*, Theo. *A. gambiae* and *A. moucheti* were most plentiful near the river. *A. nili* was found only near the river and is probably not a truly domestic species. The larvae taken comprised the same five species and *A. vinckei*, De Meillon. Breeding places of *A. gambiae* were numerous, and atypical larvae of this species were found on a grass-grown island. A list is given of the plants characteristic of the breeding places of *A. moucheti*, which were found only on grass-grown islands in the middle of the Congo when the level of the water was high, and along the grassy banks of smaller rivers. Larvae of *A. nili* and *A. coustani* were plentiful along the banks of the Congo in grass-grown pockets, but *A. moucheti* never occurred in these, though the difference between them and the islands was not apparent. Statistical analysis of the data obtained showed that seasonal variations in Anopheline abundance are due almost exclusively to *A. moucheti*, the incidence of which fluctuated with the level of the Congo river, three weeks elapsing between maximum water level and maximum abundance of adults. The population of *A. gambiae* was correlated with rainfall and that of *A. nili* with river level.

Dissection of 1,004 females of *A. gambiae* and 1,249 of *A. moucheti* showed 16 and 7·9 per cent., respectively, to be infected with malaria parasites. The numbers having gut, gland and combined infections were 49, 104 and 15 in the former and 33, 64 and 2 in the latter. No infection was found in 19 females of *A. nili*. In 1939, the parasite rates among children and adults were 80·9 and 48 per cent., respectively, and the gametocyte indices 7 and 1·7 per cent.

Bianchi (F. A.). **Notes on the Abundance of the Spiders** *Lactrodectus mactans*, *L. geometricus* **and** *Argiope avara*, **and of their Parasites on the Island of Hawaii.**—*Proc. Hawaii. ent. Soc.* **12** no. 2 pp. 245–247. Honolulu, 1945.

Latrodectus mactans, F., became extremely abundant in and around barracks at South Point, Hawaii, during the summer of 1939. In August, at least one spider was found under every stone displaced and in almost every clump of grass thick enough to provide protection, and webs were numerous on the inside and outside of the barracks. A large colony of the recently introduced Scelionid egg-parasite, *Baeus californicus*, Pierce [*cf. R.A.E.*, B **28** 223–224] was liberated over an area of about half an acre. When the locality was next visited by the author, in June 1944, the population of *L. mactans* had been so reduced that spiders and webs of this species could be found only with difficulty, but *L. geometricus*, Koch, which had not previously been seen there, had become very plentiful. There was no evidence of the presence of *B. californicus*. The reduction in the population of *L. mactans* is attributed to the better adaptation of *L. geometricus* to the local environment and not to the action of the Scelionid, though the latter is known to parasitise the eggs of *L. mactans* only.

Goodhue (L. D.), Fales (J. H.) & McGovern [*i.e.* McGovran] (E. R.). **Dispersants for Aerosols.**—*Soap* **21** no. 4 pp. 123, 125, 127, 7 refs. New York, N.Y., 1945.

Dichlordifluoromethane (Freon-12) is the most satisfactory compound for the production of insecticidal aerosols by the liquefied-gas method [*R.A.E.*, B **31** 167] if these are to be used in the presence of man or animals, as it is non-toxic, non-inflammable, inert and odourless and has a suitable vapour pressure. Owing to the difficulty of manufacturing enough of it to meet the war-time demand for aerosols of pyrethrum and sesame oil, substitutes or diluents were sought. The physical and chemical properties of several possible ones and the results of tests on the toxicity to house-flies [*Musca domestica*, L.] of aerosols produced by them are given in this paper. In the toxicity tests, the standard aerosol containing 2 parts pyrethrum (20 per cent. pyrethrins), 8 parts sesame oil and 90 parts Freon-12, was compared with variations in which the Freon-12 was replaced entirely or in part by another liquefied gas.

The compounds tested as diluents were butane, propane, dimethyl ether, methyl chloride and methylene chloride, and the first four and also chlordifluoromethane (Freon-22), chlorfluoromethane (Freon-31) and a mixture of equal parts butane and propane were tested as substitutes. An initial experiment with butane and propane showed that the latter and a mixture of the two in equal parts (which has about the same pressure as Freon-12) were as effective as the Freon in producing a toxic aerosol, but butane was less so, presumably on account of its lower pressure. Aerosols produced by mixtures of 20 per cent. by volume of butane or propane with Freon-12 were respectively slightly less and slightly more toxic than one produced by the Freon alone. Freon-31, which has a low pressure and probably some other undesirable property also, produced a coarse and ineffective aerosol. All the other gases, alone and in combination with Freon-12, produced aerosols about as toxic as those dispersed by the latter.

Propane and butane are available at low cost either alone or as blends and their toxicity to man is low, but they are not good solvents as liquids except for oily materials and are highly inflammable. However, they may be used to replace just over 20 per cent. of Freon-12 without making an inflammable mixture. Dimethyl ether has a boiling point of –9·6°F. It is much less expensive than Freon-12 and is a good solvent for many organic insecticides, especially DDT. It is not toxic to animals at much higher concentrations than that necessary to produce an aerosol, but it is highly inflammable and not more than about

25 per cent. of the Freon-12 can safely be replaced by it. Methyl chloride is next to Freon-12 in suitability for aerosol production, except for its toxicity to man and animals. It is excellent for use out-of-doors. It boils at –10·7°F., is a good solvent for nearly all organic insecticides, especially DDT, is less expensive than Freon-12 and is not inflammable in air at the concentration built up by an aerosol. Freon-22 has a boiling point of –41·5°F. and is non-inflammable and non-toxic but more expensive than Freon-12. Freon-31, which has a boiling point of –15·8°F., is a good solvent and is relatively non-toxic and non-inflammable, but the aerosol it produced was not satisfactory. Although methylene chloride is liquid at room temperature, having a boiling point of 104°F., it is easily volatilised and can be substituted for Freon-12 up to one-third of its weight without reducing the effectiveness of the aerosol. It is practically non-inflammable, and only very slightly toxic to animals. It is an excellent solvent for many organic insecticides, including DDT and rotenone, and can be used as an auxiliary to make these insecticides more soluble in Freon-12. It is concluded that it appears to be the most practical diluent for Freon-12 and solvent for insecticides.

Carbon dioxide has not been extensively tested as a propellent solvent for aerosols. It is inexpensive, but pyrethrum extract is only slightly soluble in it as a liquid, and its vapour pressure is so high that it is difficult to handle with ordinary equipment. About 16 per cent. by weight of carbon dioxide in acetone gives a pressure of 300 lb. per sq. inch and produces a rather wet, inflammable spray. In a comparative test, 2 per cent. pyrethrum, 8 per cent. sesame oil, 40 per cent. acetone and 50 per cent. kerosene used under 300 lb. carbon-dioxide pressure at 6·92 gm. solution per 1,000 cu. ft. gave a rather lower kill of house-flies than 6 gm. of the standard aerosol. Nitrous oxide has too high a pressure to be practical unless it is mixed with some low-pressure solvent. It is non-inflammable but will support combustion.

Hazard (F. O.). **Roach Repellent Cement.**—*Soap* **21** no. 4 pp. 129, 131, 133, 135, 157, 3 refs. New York, N.Y., 1945.

It has frequently been reported of recent years in the United States that cockroaches have ceased to be a nuisance in restaurants, etc., after the installation of a new flooring material made by incorporating finely divided copper powder in magnesium-oxychloride cement and known as Hubbellite. Detailed results are given of tests designed to evaluate the possible repellent properties of Hubbellite against *Blattella germanica*, L., *Periplaneta americana*, L., and *Blatta orientalis*, L. In preliminary tests, the cockroaches were exposed for 14 days in darkness in glass containers each having one half of the floor covered with Hubbellite and half with Portland cement. Their distribution was noted daily and they were disturbed to counteract their gregarious tendencies after each count. The percentages on Hubbellite in the various replications were 4–8 of *Blattella*, 11–24 of *Periplaneta*, and 6–16 of *Blatta*. Food and water were supplied in both halves in all cases. Differences between the repellency of dry surfaces and surfaces wetted with tap-, well- or rain-water to simulate mopping were insignificant. In the second series of tests, the degree of repellency was determined by varying the supplies of food and water. When water, food and both were present in only the Hubbellite side of the container, the percentages of cockroaches on this side were 14, 29 and 41, respectively, in the case of *Blattella*, 28, 23 and 23 in that of *Periplaneta* and 20, 31 and 21 in that of *Blatta*. Grey, brown, red and green Hubbellite were found to be equally repellent to *Blattella* and *Periplaneta*, but the grey was more effective than the others against *Blatta*. Hubbellite was not toxic to *Blattella*. It is believed that so far as the floor is concerned, cockroach infestations can be reduced to a minimum by the use of Hubbellite flooring.

Mackintosh (W. L. S.). **Tsetse** [and] **Trypanosomiasis.**—*Rep. vet. Dep. Uganda 1944* pp. 3–4. Entebbe, 1945.

Trypanosomiasis, mainly caused by *Trypanosoma congolense* with *T. vivax* playing a secondary part, is the gravest menace to the future of livestock in Uganda, where it exists in every district except one and is responsible for the death of many thousands of cattle yearly. The areas infested with *Glossina morsitans*, Westw., *G. pallidipes*, Aust., or both are very large and have been increasing rapidly in recent years, so that stock is becoming dangerously concentrated or dying out. The southward spread of *Glossina* in the northern areas is threatening the heavily stocked lands of the Teso and Central Districts, and all the northern and most of the western part of Buganda are now devoid of cattle. *G. pallidipes* spread into Bugerere County in 1944, causing the loss of about 11,000 cattle and the closing of the stock trade routes from Lango and Teso through Bugerere to Buganda, and it is threatening the intensive mixed farming lands in southern Buganda.

de Boer (H.). **Communicable Diseases.**—*Rep. med. Dep. Uganda 1944* pp. 5–7. Entebbe, 1945.

Frequent small showers with no heavy rainfall made conditions suitable for the mass breeding of *Anopheles gambiae*, Giles, in Uganda in 1944, and malaria became epidemic, but the epidemic was brought to a close by more intensive oiling coinciding with an improvement in the weather. In the highland district of Kigezi, malaria was reported in areas where it was not previously known to occur, and was found to be centered near swamps that were being partly drained for the cultivation of sweet potato. Dissection of Anophelines caught in huts in the affected area showed that the vector was *A. christyi*, Newst. & Cart., a species not previously considered dangerous. No cases of yellow fever were diagnosed in man during the year, but the virus was isolated once from a mixed collection of *Aëdes* mosquitos taken in a small section of uninhabited forest in Bwamba County [*cf. R.A.E.*, B **34** 28], and six strains of a virus believed to be that of Rift Valley fever were also obtained. Collection of mosquitos at various levels in Bwamba forest showed that both *Anopheles gambiae* and *A. funestus*, Giles, can be taken high above the ground in forest areas.

The spread of relapsing fever to areas not previously infested with *Ornithodoros moubata*, Murr., is attributed to the distribution of the tick by labourers entering the territory from Ruanda-Urundi in the Belgian Congo. It is proposed to establish camps for them at the place of entry and along the roads they usually follow and to disinfest their belongings in them. Sleeping sickness continued to decrease, but 150 new cases caused by *Trypanosoma rhodesiense* occurred in the Mbale and Busoga districts [*cf.* **33** 101] and on Buvuma Island in the Mengo district. Infections with *T. gambiense* occurred in the West Nile, Acholi, Bunyoro, Ankole and Toro districts, with 148 new cases in the West Nile district and 69 in the others. There was evidence that both *Glossina pallidipes*, Aust., and *G. morsitans*, Westw., have spread in recent years and that their advance during 1944 was faster than was anticipated [*cf.* preceding abstract].

Papers noticed by Title only.

Wolfs (J.). *Anopheles* (*Anopheles*) *implexus* **var.** *henrardi* **var. nova** [from the Belgian Congo].—*Rec. Trav. Sci. méd. Congo belge* no. 3 pp. 174–176, 1 fig. Léopoldville, 1945.

van Someren (E. C. C.). **Ethiopian Culicidae : Descriptions of two East African Culicine Larvae, not hitherto described, and a new Subspecies from Abyssinia (Diptera)** [all of the genus *Culex*].—*Proc. R. ent. Soc. Lond.* (B) **14** pt. 5–6 pp. 77–80, 2 figs., 3 refs. London, 1945.

Burroughs (A. L.) & Holdenried (R.). **Recovery of Relapsing Fever Spirochetes from *Ornithodoros turicata* (Dugès), 1876, in California.**—*J. Bact.* **48** no. 5 p. 609. Baltimore, Md., 1944.

In June 1944, 121 and 54 ticks of the genus *Ornithodoros* were collected from burrows of *Citellus beecheyi* in Kern County and Alameda County, California. They were divided into batches and fed on guineapigs. One guineapig was infected with relapsing fever by ticks from Kern County and three by ticks from Alameda County, the numbers of ticks in the infective batches being 19, 2, 13 and 27. Numerous specimens from both lots of ticks were identified by R. A. Cooley as *Ornithodoros turicata*, Dugès, which has been reported as a vector of relapsing fever in Mexico [*R.A.E.*, B **31** 50], Texas [**19** 116; **22** 181], Kansas [**25** 126], New Mexico [**30** 96] and Oklahoma.

Rosický (B.). **Prodromus aphanipterorum patriae nostrae.** [*In Czech.*]—*Sborn. ent. Odd. zemsk. Mus. Praze* **21–22** pp. 10–56, 3 pls. Prague, 1944. (With a Summary in Latin.)

Lists are given of the fleas that are known or likely to be found in Czechoslovakia, with records of their hosts and distribution and keys to them in Czech and Latin.

Sautet (J.) & Audibert (Y.). **Papilles anales et asphyxie des larves de moustiques.**—*C. R. Soc. Biol.* **139** no. 1–2 pp. 104–105, 1 ref. Paris, 1945.

In view of differences of opinion as to the importance of the anal papillae of mosquito larvae as an accessory means of respiration [*R.A.E.*, B **2** 107; **21** 74, 94; **24** 235], the authors carried out experiments in which the larvae were prevented from obtaining air at the surface of the water. Under these conditions, normal fourth-instar larvae of *Culex pipiens*, L., survived for 6–15 days in January at 8°C. [46·4°F.] and about one day in May at 20°C. [68°F.], while larvae from which the anal papillae had been removed survived for only 3–6 days and a few hours, respectively. Larvae of *Theobaldia longiareolata*, Macq., deprived of their anal papillae survived about five days at 8°C. in running water and generally two days at 18°C. [64·4°F.] in stagnant water containing less dissolved oxygen. It is concluded that it is during the diapause and at temperatures normal in France that the anal papillae seem to play a part in respiration. When the rate of metabolism is high, the oxygen requirements are so great that the weak respiration of the papillae can be disregarded. It varies considerably with the species of mosquito, the instar, the dissolved oxygen and temperature.

Vazquez (L.) & Nieto Roaro (D.). **Nota acerca del estudio del paludismo en Izucar de Matamoros, Pue., en la epoca seca del invierno.** [Note on a Study of Malaria in Izucar de Matamoros in the dry Season.]—*An. Inst. Biol. Méx.* **14** no. 1 pp. 83–92, 1 map, 8 figs., 8 refs. Mexico, D.F., 1943.

This paper deals with an investigation on the incidence and transmission of malaria in the dry season in a district in the State of Puebla, southern Mexico, where the disease is endemic. The surroundings and climate are briefly described. All blood samples examined from persons suffering from malaria and living near Anopheline breeding places showed the presence of *Plasmodium falciparum*, but among samples from 100 school children one contained *P. falciparum*, three *P. vivax* and three *P. malariae*. The vector was *Anopheles pseudopunctipennis*, Theo., the only species that can pass the winter in the dry interior of southern and western Mexico [*cf. R.A.E.*, B **27** 122]. At the time of the survey (late November and early December), it was breeding in sunlit backwaters and pools

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left by the falling river and in drainage pools and ditches in rice fields with clear water and green algae. The most abundant alga found in all winter breeding places was *Hydrodyction reticulatum* [*loc. cit.*] with *Cladophora* sp., and *Pithophora* sp. less plentiful. Larvae were also seen in the clear water of a spring. Almost all the adult Anophelines collected in dwellings were females and all these had had recent blood meals. It is concluded that an effective campaign could be carried out against the larvae in winter when the breeding places are not extensive.

BUXTON (P. A.). **The Use of the new Insecticide DDT in Relation to the Problems of tropical Medicine.**—*Trans. R. Soc. trop. Med. Hyg.* **38** no. 5 pp. 367–400, 32 refs. London, 1945.

The chemical characteristics of DDT are reviewed and its toxicity to mammals and effectiveness against Arthropods of medical importance are discussed with reference to the work of various authors and unpublished results of British workers. The toxicological evidence on experimental animals indicates that there is no risk from dry DDT or water suspensions, whether they are on the skin or swallowed, but in the presence of solvents, including edible fats, DDT is absorbed through the skin or from the alimentary canal. Large doses give rise to symptoms, but animals (and presumably man) recover after symptoms and liver changes have developed if no more DDT is taken. From the observation of numbers of men who have handled large quantities of DDT in manufacture and in use without showing ill effects, it is concluded that DDT used as an insecticide is quite safe. There is field evidence from several areas that DDT is toxic to fish.

A brief account of the general insecticidal characteristics of DDT is followed by a review of knowledge on its application against Arthropods. Used as a spray to deposit a toxic residue in houses for the control of Anophelines, it has a much more lasting effect than pyrethrum, a single application often keeping numbers low for two or three months. A dosage of 100 mg. per sq. ft. should be applied for the present, but probably a much smaller amount will later be found sufficient [*cf. R.A.E.*, B **34** 98, 99 ; 128, 129]. The necessity for further study of the habits of different species of *Anopheles* in houses is pointed out. The impregnation of relatively wide-meshed bed nets would probably make them effective barriers against the smaller species and also against such small insects as *Phlebotomus*. For use as a dust against mosquito larvae, DDT has to be ground with an inert mineral and it is prepared as a 10 per cent. mixture, so that the problem of transport is considerable [*cf.* **34** 99], but added to larvicidal oils, it has made it possible to reduce the amount of oil from 10–20 gals. per acre to less than 1 gal. [**34** 130]. A dosage of 1–2 quarts per acre of a 5 per cent. w/v solution of DDT in an oil of good spreading power is suggested. Under ideal conditions, a much smaller dose is lethal [**34** 5]. Application in oil solution would generally be preferable to dispersion in colloidal form through the water [**33** 77–78], which seems wasteful and dangerous to insects that are predacious on mosquito larvae. Dispersion might, however, provide means of controlling the larvae and pupae of *Simulium*, which live completely submerged. Distribution by aircraft of DDT in oil was originally regarded only as a larvicidal measure, but large numbers of adults are killed, not only if they are in flight while the spray is being applied, but also if they alight on surfaces on which a toxic residue has been deposited [*cf.* **34** 99].

The present British official recommendation for a spray for the control of adult flies (*Musca*) and mosquitos is 0·07 per cent. pyrethrins or more if available, or 0·05 per cent. pyrethrins and 0·3 per cent. DDT (pure para para compound), or 0·03 per cent. pyrethrins and 0·5 per cent. DDT [*cf.* **34** 4] applied at 10 cc. per 1,000 cu. ft. (1 fl. oz. per 3,000 cu. ft.). However, a toxic residue is probably even more valuable against flies than the sprays themselves

[**32** 174, 201]. There is evidence that the adults of many Muscids, including *Calliphora*, *Lucilia*, *Chrysomyia* and *Stomoxys*, are very susceptible to DDT in this form, so that it may prove valuable in tropical slaughter houses and meat markets, and animals may also be sprayed with kerosene solutions or emulsions of it to kill blood-sucking flies [*cf.* **32** 203]. The author observed a great reduction of *Stomoxys* and a blood-sucking species of *Musca* in West Africa following the spraying of one cow out of a herd of a dozen that were suffering greatly, and preliminary work by himself and T. A. M. Nash has shown that *Glossina* spp. are very readily killed by traces of DDT on cloth. Work on an emulsion of DDT against larvae of *Musca domestica*, L., has been done in Florida [**32** 203].

DDT applied in various ways has proved of great value against *Pediculus humanus*, L. [**32** 197; **34** 126, 127]. Dusts are also effective against head lice [*P. h. capitis*, Deg.] and *Phthirus pubis*, L., and some work has been carried out in Britain on the use of emulsions to impregnate the hair of the head. J. R. Busvine found that a dose of 0·2 gm. DDT completely protects the head for a week, but sometimes begins to lose its effectiveness after a fortnight. DDT is the most useful material known for the control of bed-bugs (*Cimex lectularius*, L.) and should end widespread infestation if used intelligently by the community [*cf.* **32** 197]. Busvine's data indicated that the doses of DDT that kill bed-bugs and lice on dry impregnated paper do not differ greatly. Both insects are much more resistant than flies or mosquitos. The concentrations in oil solution that are lethal when sprayed directly on to bed-bugs or lice are also not greatly different. The concentrations needed to give about 50 per cent. kill of insects on petri dishes when the spray was applied at 0·35 mg. per sq. cm. were 0·34 per cent. for lice and 0·56 per cent. for bed-bugs. The results of S. Barnes [**34** 26, 92] do not altogether support the rather far-reaching claims based on preliminary work done elsewhere. The active isomer of benzene hexachloride [**33** 130] sprayed on surfaces is more effective against *C. lectularius* [*cf.* **33** 131] than pure DDT, but its effect is not so lasting. Extermination of bugs with DDT has already been effected in gaols, barracks and ships in many parts of the world. It seems that about 100 mg. per sq. ft. is likely to be satisfactory for about three months. Such a dosage may be attained by applying a 5 per cent. solution in kerosene with a coarse nozzle held close to the wall so that the wall looks wet but the liquid does not run off. One quart of spray should cover 300 sq. ft. Dusts containing 5 or 10 per cent. DDT have been used successfully but are more likely to be removed than a spray deposit. Busvine sprayed a bakery infested with *Blatta* [*orientalis*, L.] at the rate of 100–150 mg. per sq. ft., and the cockroaches that were hit by the spray died, but there were many live ones on the film a week later. The same worker greatly reduced an infestation of *Monomorium pharaonis*, L., by spraying the walls with 5 per cent. DDT in kerosene at 100 mg. DDT per sq. ft. A 5 per cent. powder is effective against fleas [**32** 205]. Notes are given on work on Trombiculids [**32** 200, **34** 143] and ticks [**32** 199, 200].

During the discussion, G. Macdonald reported that in six months' experience of the field use of DDT no case of systemic poisoning had been seen. Surfaces treated with 200 mg. per sq. m. [18·6 mg. per sq. ft.] remained lethal to *Anopheles maculipennis*, Mg., for ten weeks. Higher doses gave a slightly prolonged effect, which was not in direct proportion to the amount applied. He recommends that in practice 500 mg. per sq. in. [46·5 mg. per sq. ft.] should be aimed at and considered effective for eight weeks. Oil solutions and emulsions reduce mosquito populations in rooms to 2 per cent. or less of their previous density, and dusts to 10 per cent. This reduction is maintained for 8–10 weeks and is due to killing and not repellent effect. There is no evidence that the population of Anophelines in neighbouring untreated rooms is affected. DDT dust used as a mosquito larvicide had no advantages in immediate effect over Paris green and no great lasting effect. When a 5 per cent. solution in oil is applied

at 10 mg. DDT per sq. m. [0·93 mg. per sq. ft.], the film is about half a micron thick and therefore unstable. H. J. Crauford Benson noted a decrease in the gross Anopheline count in six rooms from 2,338 to 31 ten days after the treatment of neighbouring breeding places. When Paris green was substituted for DDT as a larvicide, the adults in the neighbouring houses increased by 10 per cent. of their previous number. Prolonged effect was obtained in small areas of water by introducing balls of a mixture of plaster of Paris and sawdust incorporating DDT.

K. Mellanby reported that a saturated solution of DDT in oil or an emulsion in water applied to the human skin killed less than 50 per cent. of *Sarcoptes* [*scabiei*, Deg.] in 24 hours, whereas benzyl benzoate emulsion or sulphur ointment kills well over 99 per cent. [*cf.* **33** 160]. J. A. Sinton quotes from a report by Scharff, who has carried out extensive work with DDT in India and on the Assam-Burma frontier, to the effect that almost complete control of Anophelines in village huts was maintained for a month after spraying with a 5 per cent. DDT solution in kerosene at 1 quart per 1,000 sq. ft. (about 50 mg. per sq. ft.) and a substantial reduction in population continued for at least a further month. A team working in East Africa under D. Bagster Wilson report that they needed as much as 200 mg. per sq. ft. to get the maximum effect in tents, but 50 mg. gave good results for as long as three months.

DAVID (W. A. L.). **Factors influencing the Interaction of insecticidal Mists and flying Insects. Part II. The Production and Behaviour of Kerosene Base insecticidal Spray Mists and their Relation to flying Insects.**—*Bull. ent. Res.* **37** pt. 1 pp. 1–28, 1 fig., 17 refs. London, 1946.

The following is based on the author's summary and conclusions. The degree of atomisation attained by a spray gun depends on the design of the nozzle, the spraying pressure, the relative rate of liquid and air flow through the nozzle, and such physical properties of the spray fluid as viscosity and surface tension. All atomisers produce droplets of a variety of sizes, but their size and velocity are greatest as they leave the gun and are carried along by the air current, and their chance of striking an insect is therefore much greater at this stage than it is later. A non-toxic carrier can increase the apparent toxicity of a spray mist by helping in the production of the necessary momentum. On the other hand, a reduction in the size of the droplet decreases the rate of loss from the air space by precipitation. In connection with evaporation, the enormous change in concentration that occurs should be borne in mind. The smallest droplets will have entirely evaporated within a few minutes, leaving only the non-volatile solute, and the droplet will have become super-saturated before this stage is reached. Finally, the non-volatile solute will exist as minute nuclei, which, when they result from a formula containing up to about 5 per cent. non-volatile material, may be so small as to settle only very slowly.

The response of the insect to the spray mist depends on its resistance and the dose of insecticide picked up. Since the mist takes time to become evenly distributed and is more easily picked up during or immediately after spraying and by insects in flight, the dose received by individual insects will vary considerably unless they behave identically. There is therefore little correlation between the comparative effect recorded on individuals and their relative innate resistance.

The behaviour of a kerosene mist (with and without added non-volatile ingredients) in a spray chamber of 54·5 cu. ft. capacity [*R.A.E.*, B **34** 90] was investigated by using a sintered glass filter funnel to collect the total mist in the air space, a glass plate on the base to collect the deposited spray, the Cascade Impactor (recently described by the designer, K. R. May) to investigate the general characteristics of the spray cloud and a sliding impactor (described

in this paper) to measure the actual particle size distribution and to count the number of particles per unit volume. It is concluded from the results that the size of the particles in the mist, initially dependent on the characteristics of the atomiser and spray fluid, is subsequently largely determined by the ability of the particles to evaporate, as expressed chiefly by their size, the vapour pressure, and the quantity of vapour already present in the surrounding atmosphere. The presence of vapour greatly retards evaporation of the droplets even when the atmosphere is far from being saturated. If the spray contains materials of low vapour pressure, the percentage of these present determines the ultimate particle size. The effect of changing the spraying pressure on the particle size of the mist is largely masked by precipitation and evaporation. The difference in particle size in the mist obtained with odourless kerosene and a white oil sprayed through the same gun at the same pressure, was to a large extent an expression of the greater rate of evaporation of the former. Rapidity of evaporation of the carrier reduces the size of the particles recovered and increases the quantity of any non-volatile material present in the original spray that remains in suspension in the air space. When non-volatile material is present in the spray, this, by failure to evaporate, determines the ultimate particle size of the mist. When the volume of a volatile spray injected into the chamber is increased, evaporation of the droplets is retarded so that they persist longer at a greater size and so more readily come in contact with the insect. The number of particles per unit of air space decreases with time, and a much greater number remains at a countable size when an appreciable quantity of non-volatile material is incorporated in the spray. Whenever the attempt has been made, it has been possible to show that a decrease in the quantity of spray mist in suspension in the atmosphere and a decrease in particle size of the mist as measured by the sampling devices used are attended by corresponding reductions in insecticidal efficiency as measured on *Aëdes aegypti*, L. In assessing the insecticidal efficiency of a mist, it is not enough to know the quantity of insecticide in suspension in the atmosphere. The particle size distribution must also be known. All tests were carried out with *A. aegypti* and the results obtained may not be applicable without modifications to other insects.

RIBBANDS (C. R.). **Effects of Bush Clearance on Flighting of West African Anophelines.**—*Bull. ent. Res.* **37** pt. 1 pp. 33–41, 2 figs., 7 refs. London, 1946.

Early in 1942, attempts to reduce the numbers of Anophelines in military camps by bush clearing were in progress in the Gold Coast. In view of divergent opinions in the literature on the effectiveness of this measure [*cf. R.A.E.*, B **21** 131; **27** 211], experiments were made to ascertain its value. The principal one was carried out in the first three months of 1942 at Krabonekrom, formerly an aggregation of mud huts harbouring large numbers of *Anopheles funestus*, Giles, and a few *A. gambiae*, Giles [**34** 91]. These were breeding in a large permanent swamp 880 yards to the east. All except three of the huts were pulled down in January, two of those remaining were thereafter kept constantly occupied, and the numbers of Anophelines attracted to them before and after clearing were compared. The bush was cleared for an average distance of 140 yards round the experimental huts. Control catches were made in huts 190, 650 and 880 yards away, and the numbers of Anophelines attracted to the experimental huts were considered as proportions of the number attracted to the control huts. The bush varied in height from 4 to 15 feet.

The proportion of females attracted to the experimental huts in the 21 days after clearing was at least 90 per cent. of the proportion that reached them in the same period before clearing, and this small decrease was probably not significant. Male Anophelines entered the cleared area in the same proportion

after clearance as before it. There was a temporary marked reduction in infestation while clearing was in progress. The proportion of females attracted at that time declined to between a quarter and a third of the proportion attracted before clearing, and the proportion of males fell to half; females were apparently much less able to discriminate between quantitative olfactory stimuli. Both effects are attributed to masking of the attracting scent of the inhabitants of the huts by an obscuring odour from the cut and withering bush.

In an observation made at Aberdeen, Sierra Leone, in August–September 1941, substantially equal numbers of *A. melas*, Theo., were attracted to a hut screened by a belt of dense high bush 10 yards thick and an identical hut in a clearing 25 yards away.

MUSGRAVE (A. J.). **Tests on Clothing impregnated with DDT as an anti-louse Measure.**—*Bull. ent. Res.* **37** pt. 1 pp. 43–56, 10 refs. London, 1946.

An account is given of simple laboratory tests carried out to appraise the usefulness of clothing impregnated with DDT for the control of *Pediculus humanus humanus*, L. (*P. h. corporis*, Deg.) In the first of the two methods used, metal boxes containing lice and pieces of the fabric under test were kept fastened against the leg of a volunteer, and in the second, lice were made to crawl on impregnated fabric under inverted glass dishes. The box method was compared with the more complicated sleeve method of testing [*R.A.E.*, B **33** 109] and was found to give an essentially similar result. Immature lice were less susceptible than adults when exposed for a short time or to a low dosage, but when exposure was fairly long, there was much less difference, and, for convenience, adults were used in all routine tests. The DDT content of pieces of garments was assessed with reasonable accuracy by comparing their effect on lice with that of pieces of standard garment of known DDT content. Differences in the nap of the cloth appeared to be unimportant, but it is suggested that the chief cause of loss of toxicity is loss of nap. Insecticidal power was transferred from impregnated garments to unimpregnated ones kept in contact with them, probably by the shedding of small fibres, and also from treated fabric to rough-surfaced paper in which it was stored. Garments lost their insecticidal efficiency more quickly on some wearers than on others, probably on account of differences in the amount of body hair and friction due to muscular exercise.

Mortality was high or complete among lice that had crawled for three hours on fabrics impregnated with 0·1–1·75 per cent. DDT by weight, but when the content was low, signs of poisoning sometimes did not appear for six hours. The minimum effective content of DDT appeared to be 0·1 per cent. [*cf.* **34** 127], but a higher content would be needed by those in regular contact with heavily infested individuals. Some garments originally treated with 1 per cent. were found to have 0·1 per cent. after being worn for three weeks and washed five times. A piece of shirting impregnated with 1·2 per cent. DDT was completely insecticidal after being boiled for half an hour in soap and water. Cotton drill impregnated with 1 per cent. remained effective after storage for 15 weeks in a saturated atmosphere at 86°F. The growth of moulds did not affect toxicity. Calico and cellular cotton were effective after storage at 86°F. for nine weeks, during which time they were washed in cold, soapless water almost daily. A shirt bearing 0·5 per cent. DDT and washed once was very effective after being stored for a year in a dry atmosphere at 86°F., and a man estimated to be harbouring 1,000 lice was practically freed of adults in one week and completely cleared of all infestation in three weeks by wearing a shirt containing 0·5 per cent. DDT.

The symptoms caused in lice by DDT are briefly described, and it is suggested that it enters them through the tactile sense organs.

HADDOW (A. J.). **The Mosquitoes of Bwamba County, Uganda. IV. Studies on the Genus *Eretmapodites*, Theobald.**—*Bull. ent. Res.* **37** pt. 1 pp. 57–82, 9 figs., 10 refs. London, 1946.

In the course of a study of the mosquitos of Bwamba County, Uganda [*cf.* *R.A.E.*, B **33** 189; **34** 28], it was found that several species of *Eretmapodites* were quite common in the forest. Mosquitos of this genus are known to have transmitted yellow fever experimentally [**16** 236], and three strains of a virus closely related to that of Rift Valley fever and perhaps identical with it have recently been isolated from mixed lots of *Eretmapodites* spp. collected in the uninhabited Bwamba rain forest. Records are given of experiments showing that the larvae are predacious on other mosquito larvae, etc. [*cf.* **31** 182], sometimes very actively so. Those of the six species examined had a group of thickened comb-like hairs on the medio-ventral surface of the mouth-brushes, similar to those of the larvae of *Culex tigripes*, Grp., which are also predacious [**31** 88]. The females of all the Bwamba species bite man by day, sometimes in large numbers, and there is a marked peak of activity in the late afternoon.

The taxonomy, morphology and bionomics of the eight species found are discussed, and the larva and pupa of *E. inornatus*, Newst., *E. penicillatus*, Edw., *E. ferox*, sp. n., and *E. leucopus* subsp. *productus*, Edw., the female of the second and adults of both sexes of the third are described for the first time, with special reference to the range of individual variation. Keys to all the known larvae, pupae and adults of both sexes of *Eretmapodites* spp. are given.

EDNEY (E. B.). **An Apparatus for handling small living Insects.**—*Bull. ent. Res.* **37** pt. 1 pp. 83–87, 3 figs. London, 1946.

Details are given of the construction and operation of an apparatus that was designed for the rapid microscopic examination of large numbers of fleas, but could be adapted for use with other insects of similar size. It enables one flea of a number in a beaker to be drawn through a tube by a current of air and trapped uninjured between a coverslip and slide in position on the microscope. After it has been examined, it is drawn through another tube into an appropriate sorting bottle. The whole of its passage through the apparatus can be completed in 15 seconds.

STEWART (J. L.). **Eradication of *Glossina* in the Naboggo Valley, Gold Coast.**—*Bull. ent. Res.* **37** pt. 1 pp. 99–103, 8 refs. London, 1946.

Trypanosomiasis, with a high mortality rate, occurred among the usually fairly resistant local dwarf cattle when they were moved to the new Pong-Tamale Veterinary Station built in the Naboggo Valley, Gold Coast, in 1930–31, and work for the control of *Glossina palpalis*, R.-D., and *G. tachinoides*, Westw., many of the results of which have already been noticed [*R.A.E.*, B **25** 221–224; **27** 99, etc.], was immediately undertaken. The district is described. The original intention was to clear only that part of the river within easy reach of Pong-Tamale station and make barrier clearings at either end to exclude the fly, but the plan was later extended to comprise the whole valley, including two tributaries. Clearing is now limited to the trees growing within the river banks [*cf.* **21** 12], almost all of which are degenerate forest species that cannot become re-established when a river is cleared from the source downwards [*cf.* **34** 18 19]; the savannah trees do not tend to extend into this area. The method adopted has already been noticed [**22** 237]. The predominant fly was *G. tachinoides* [*cf.* **21** 12; **22** 237; **24** 56], and before clearing there was always a certain fly population on the Naboggo, even during flooding [**25** 223]. *G. palpalis* was found mainly at river crossings and watering places frequented by man, and on one of the tributaries that flowed through a thickly populated

area, it constantly represented 4 per cent. of the flies taken until eradication was complete. Fly-boys were more efficient than traps [*cf.* **24** 56] for extermination of populations, and in one test carried out over a period of two months, boys holding khaki, grey and dark brown screens in front of them caught, respectively, 15·7, 21·6 and 29·5 flies per day on the screens while a boy without a screen caught 32·8 flies per day. Flies of the group of *G. palpalis* have rarely been found more than 500 yards from tsetse cover in the dry season, but ten miles is considered the range of flight of both *G. palpalis* and *G. tachinoides* during the rains. The River Volta is slightly under ten miles from Pong-Tamale, and in September, when conditions are wettest, a few flies are always caught in the main farm and laboratory area to the west of the main road, but none on the east side. Release of marked flies at each end of the clearing every year shows that the Volta with various ponds and re-entrants around its confluence with the Naboggo, is the only source of infestation. Further clearing is to be carried out in that area.

The Pong-Tamale area was over-stocked in 1944, so that at the height of the flood period cattle had to go into the neighbourhood of the Volta to graze and here they were easily accessible to tsetse, which followed them back. Numerous bullocks became infected with trypanosomiasis, and 10 per cent. died. In 1943, imported zebus from the French Sudan were attacked by *G. morsitans submorsitans*, Newst., at the crossing of the White Volta and followed by the fly to the collecting centre on the banks of the Naboggo four miles north of Pong-Tamale. The trypanosomiasis set up was mainly caused by *Trypanosoma vivax*, the species responsible for over 90 per cent. of animal trypanosomiasis in the Gold Coast. It was very virulent, and most local herds in villages through which these imported cattle passed became infected. *G. morsitans submorsitans* did not penetrate south of the Naboggo, as it was exterminated by the fly-boys.

Cleaning the banks has not led to erosion because the river runs very slowly, but it would probably do so on fast-flowing rivers. Clearing a tropical river of its fringing bush should be followed by development, with water conservation, anti-flooding measures and perhaps irrigation. Little maintenance work is necessary if the initial burning of the roots is thorough [**22** 237], but some attention is necessary for the first few years to keep down the few shrubs and trees that may re-establish themselves. In 1945, there was a severe drought, with the usual rains three months later. There were several thousand cattle in the Naboggo valley, and though grazing was somewhat inadequate towards the end, large numbers of cattle were maintained in fair condition.

RIBBANDS (C. R.). **The Use of DDT as a Mosquito Larvicide on flowing Water.**—*Bull. ent. Res.* **37** pt. 1 pp. 105–112, 4 refs. London, 1946.

Two of the experiments described on the effectiveness of DDT as a mosquito larvicide on flowing water involved the treatment in April 1944 of small irrigation channels about 2 ft. wide in Ceylon where *Anopheles hyrcanus*, Pall., and *A. aconitus*, Dön., were the predominant Anophelines, and the third consisted of the treatment in June 1945 of a river in Assam in which *A. minimus*, Theo., was the principal species breeding. The treatments were made with crude DDT containing 70–75 per cent. of the para para compound, which was dissolved at the rate of 8 oz. per gal. (5 per cent.) in waste engine oil for use in the ditches and in a mixture of 75 per cent. kerosene and 25 per cent. waste engine oil for the river. Application was made at one point only, and the whole dose was applied at one time.

The quantities of solution applied in Ceylon were 10 and 20 cc. The smaller quantity destroyed 97 per cent. of Anopheline larvae for 100 yards below the point of application with the water flowing at 12 and 15 ft. per minute, and 29 per cent. for the same distance with a flow of 35–50 ft. per minute. It destroyed 96 and 74 per cent. of other mosquito larvae when the water flowed at 12 and

15 ft. per minute, respectively, and was ineffective at a flow of 35–50 ft. The larger quantity killed 99 per cent. of Anophelines for 300 yards in a channel with a gradually decreasing rate of current, and 97 per cent. for the first 100 yards, which had a flow of 33–50 ft. per minute, and 92 and 52 per cent. of other mosquito larvae in the 300 yards and the uppermost 100 yards, respectively. Hence, the amount of solution required is proportional to the rate of flow of the stream. Where this did not vary, kills of mosquito larvae other than Anophelines were considerably greater 200–300 ft. below the place of treatment than within 100 ft. of it. DDT as a 2 per cent. powder with wood ash was much less effective than the same quantity in oil, and waste engine oil without DDT was quite ineffective in small doses. DDT in oil is probably not lethal to Anopheline eggs [*cf. R.A.E.*, B **34** 29], but it is thought that it clung to them and killed all larvae hatching from them, because the reduction in the number of first-instar larvae after treatment was as great as that of larvae of other instars. DDT in wood ash caused no reduction of first-instar larvae.

Only Anopheline larvae were considered in the experiment in Assam. The river was 30 ft. wide, with a winding course and a current of about 75 ft. per minute. Anopheline larvae were searched for at selected points for 2,280 yards along the bank from which the solution was applied. In the two tests in which 2 gals. of solution was applied control was complete, or practically so, over the whole 2,280 yards. On the first occasion, no larvae or pupae were found until the third day after treatment, and on the second, only one larva and two pupae were found on the day after treatment, while 89 larvae and pupae had been found the day before. As pupae are much less numerous than larvae, the survival of two suggests that they are much less affected by DDT. The mosquito population returned rapidly to normal from the third day onwards, and pupae of both *A. minimus* and *A. varuna*, Iyen., were obtained on the eighth day after treatment. The partial effect of smaller quantities of solution (1 or 4 pints) was greatest several hundred yards downstream, because the film of oil persisted longer there than nearer the point of application, though it was thinner. There was some evidence that larvicidal effect persisted longest at the places furthest from the point of treatment, possibly because the DDT finished passing through these places later. It is suggested that the DDT might have been used more economically if the oil film had been distributed at the outset by applying the solution just above a partial boom or through a coarse drip can or in fractions at intervals. There was no evidence of any marked variation in effectiveness attributable to differences in the angles of the examined stretches of river in relation to the current. Eddies and backwaters retained the oil, prolonging effectiveness. This is of importance in the control of *A. minimus*, which breeds in the weed-covered edges of streams where the flow is slowest. It was not possible to make observations more than 2,284 yards from the point of treatment.

In the author's experiments on still water, the effectiveness of DDT was such that he thought it might act in a monomolecular film of oil [**34** 29]. N. K. Adam has calculated that at 0·2 pint 5 per cent. DDT in oil per acre, which was markedly lethal in these tests [*cf.* **34** 28], the DDT film would be 1–2 monolayers thick and the oil film probably about 20 molecular layers. Hence, the widely spreading lethal effects of DDT in oil are probably due to the spreading of very thin multimolecular films of oil, containing about a monolayer of DDT.

GOLDING (F. D.). **A new Method of trapping Flies.**—*Bull. ent. Res.* **37** pt. 1, pp. 143–154, 2 graphs, 5 refs. London, 1946.

A method of catching moths by means of an adhesive prepared from three parts of até (the coagulated latex of *Carpodinus hirsuta*) and one part of shea butter (from *Butyrospermum parkii*) or palm oil (from *Elaeis guineënsis*) [*cf. R.A.E.*, A **30** 212] has been used with success in hospitals, kitchens, dairies,

cow byres and pig pens in Nigeria against *Musca* spp. and *Stomoxys* spp. When the mean maximum temperature exceeds 85°F., it is advisable to increase the ratio of até to oil to 4 : 1. The method of preparation is described. The adhesive is best used on wires with a diameter of about 4 mm. suspended by hooking them on to a horizontal string at intervals of 9–12 inches. When renewal is necessary, the trapped flies and old adhesive are burned off the wires. The odour of the fresh adhesive attracts flies, and the best catches are obtained during the first 24 hours. Also, the viscosity of the adhesive gradually deteriorates, so that it is advisable to renew it every week or every three or four days when flies are abundant.

Ten wires suspended in the kitchen over the table where food is prepared will keep a house practically free of flies. It is advisable to attach a small wooden platform to the end of each wire, as a mass of flies and adhesive may drop off the wire in hot weather. For two years from 31st July 1942, trapping was carried out in the kitchens of all occupied houses at the headquarters of the Nigerian Agricultural Department at Ibadan and catches estimated each week. At first six broom strands were used [*cf. loc. cit.*] and later ten wires. Catches appeared to be correlated with temperature but not with relative humidity. Populations began to increase in February and were greatest in May. The mean catch per kitchen during the two years was 269 flies per week. Nearly all were *Musca domestica vicina*, Macq., but *M. cuthbertsoni*, Patt., was occasionally present. When two or three neighbouring houses were particularly heavily infested, it was often possible to discover the breeding place and eliminate it. Wires and broom strands suspended alternately over a kitchen table trapped 59 and 41 per cent. of the total catch, respectively. It is thought that flies may escape more easily from the strands, which are thinner, and that the wires, being better conductors of heat, may improve the viscosity of the adhesive. In similar experiments in pig pens where both *Musca* and *Stomoxys* were present, the relative efficiency of the wires increased as the proportion of *Stomoxys* decreased. *S. nigra*, Macq., appeared to be more successful than *Musca* in freeing itself.

Of 131 blood-sucking flies taken from pig pens at Ibadan in June 1942, 122 were *Stomoxys nigra* and the others *S. calcitrans*, L. Each pen consisted of a covered section and an open yard separated by a half-wall. A screen of oil palm fronds was erected above the half wall and made the inner part too dark to attract flies. The best trapping site was found to be under the eaves of the thatched roof, and ten strands or wires were placed in that position in each of the 12 pens. About half a million flies, of which about 27·5 per cent. were *Stomoxys* spp., were trapped in 112 weeks. The seasonal incidence of non-biting flies (*M. d. vicina* and *Chrysomyia putoria*, Wied.) agreed with the findings in the kitchens, and that of *Stomoxys* was closely correlated with rainfall, increasing sharply in June. *S. nigra* was scarce during the dry season, and several generations were required to build up the population after the onset of the rains in March, the life-cycle lasting 3–4 weeks. The distribution of *Stomoxys* and non-biting flies in the pens was very similar. Pens with the youngest pigs had the smallest numbers of flies, pens in the sun were more heavily infested than those in shadow, and infestation was also greater in pens sheltered from the prevailing wind. Seven individuals of *Glossina palpalis*, R.-D., were caught on the strands, although the nearest river was almost 400 yards away. One was taken in the middle of the dry season and the others between May and October.

Although adults of *S. nigra* were about 15 times as numerous as those of *S. calcitrans* in pig pens and elsewhere, the vast majority of the adults bred from larvae taken in the field belonged to the latter species. The reason for this is not known. Breeding took place in cow dung in byres and in the field and in decomposing vegetation, but there was no evidence that either species bred in pig manure. In an experiment in which heaps of grass and dicotyledonous

plants were wetted with water or urine from a dairy, small numbers of *S. nigra* were bred from all piles, but *S. calcitrans* emerged only from the heaps wetted with urine. There was evidence that the life-cycle of *S. nigra* could be completed in 17 days and that of *S. calcitrans* in 20 days at a mean maximum temperature of 90°F. and a mean minimum temperature of 72°F. [*cf.* **17** 20]. In addition to attacking cattle and pigs, both species frequently obtained blood from the combs of cockerels and were undoubtedly responsible for transmitting fowl-pox. Apart from lizards, the only natural enemy of *S. nigra* observed was an entomogenous fungus (probably *Empusa* sp.) that destroyed large numbers between July and September 1944. The main breeding sites of *M. d. vicina* were latrines, trenching grounds, pits containing pig manure and bedding, slaughter house refuse and heaps of rotting food; *M. cuthbertsoni* bred in cattle droppings, palm kernel meal and pig dung. On one occasion, 39 adults of *M. gabonensis*, Macq., were bred from a heap of cow dung. The principal breeding sites of *C. putoria* were pig dung and bedding, mud near a pig pen drain and palm kernel meal.

Ikawa (M.), Dicke (R. J.), Allen (T. C.) & Link (K. P.). **The principal Alkaloids of Sabadilla Seed and their Toxicity to *Musca domestica* L.**—*J. biol. Chem.* **159** no. 2 pp. 517–524, 1 graph, 15 refs. Baltimore, Md., 1945.

Laboratory investigations are described showing that the agent responsible for the toxicity of kerosene extracts of the ground seeds of sabadilla (*Schoenocaulon* sp.) to *Musca domestica*, L. [*R.A.E.*, B **33** 65] is contained in the alkaloids (veratrine), although they are soluble in kerosene to only a limited extent (0·1-0·2 per cent.). By adsorption of the alkaloid mixture on a column of aluminium oxide, three fractions differing in toxicity were obtained, and cevadine and veratridine were isolated as their crystalline dilituratcs. When tested by the settling-mist method [*cf.* **31** 210], veratridine in kerosene was found to be highly toxic to *M. domestica*; cevadine exhibited less toxicity. Both alkaloids, as well as the remaining alkaloid mixtures, gave very quick and complete knockdowns. Cevine and cevine dibenzoate showed no toxicity in kerosene, and the oil extracted from sabadilla seed gave good knockdown but no mortality.

Matthysse (J. G.). **Large Scale Power Dusting of Feeder Lambs for Winter Control of the Sheep Tick.**—*J. econ. Ent.* **38** no. 3 pp. 285–290, 6 figs. Menasha, Wis., 1945.

Many thousands of western range lambs are taken every winter to western New York to be fattened for three or four months before being slaughtered. Practically all are infested by *Melophagus ovinus*, L., many of them heavily, but it is concluded from the experiments described in this paper that power dusting is a satisfactory method of control. It is safe in cold weather, when dipping is injurious to the lambs, and is less expensive and quicker than dipping. The lambs are sent through a chute past a bank of duster nozzles, and the dust is applied by a high-powdered machine such as a five horsepower, 18-nozzle, crop duster. Under commercial conditions, probably 2,000 lambs could be dusted in a day. The most effective dust used was a mixture of 1 part cubé (4·8 per cent. rotenone) and 10 parts Pyrax ABB (pyrophyllite) with the addition of 2 per cent. motor oil, which gave about 90 per cent. mortality of the adults in two days. Pupae were not affected, but most of the adults that emerged during the period of fattening were killed by the remaining dust.

In no case were any ill effects to the lambs or the operators reported from this dust, and the oil reduced the dust cloud so that rotenone irritation to the operators was slight. Cubé dusts containing sulphur were irritating to the eyes of the operators, and 5 per cent. DDT dust was ineffective.

Bruce (W. G.). **Screwworm Survey of the southeastern States in 1944.**—*J. econ. Ent.* **38** no. 3 pp. 327–329, 1 fig., 1 ref. Menasha, Wis., 1945.

The survey of infestation by *Cochliomyia hominivorax*, Coq., (*americana*, Cush. & Patt.) in livestock in the south-eastern United States begun in 1943 [*R.A.E.*, B **33** 148] was continued throughout 1944. Reports revealed infestations throughout Florida, the southern three-quarters of Georgia and the southern third of Alabama and in most of South Carolina, but the total numbers of animals infested and the loss of livestock due to infestation were considerably lower than in 1943, despite favourable weather, because of the practice of recommended control measures where possible. Shortage of labour prevented more effective control, especially among cattle on open ranges. The principal factor contributing to the maintenance of populations of *C. hominivorax* is thought to be the thousands of pigs that roam in the woods untended and heavily infested. Activity was found throughout peninsular Florida in every month of the year, and cases were reported in each month of the winter of 1943–44 in southern Georgia. Infestations reached outbreak proportions only in local areas in these two regions, where they occurred usually in the navels of newly-born calves and pigs, and in castration, ear-marking and branding wounds in spring and in the lesions caused by *Amblyomma maculatum*, Koch, in late summer and early autumn. Case incidence ranged from 0·5 to 5 per cent. of all livestock in Georgia, except in the coastal plains, where 12 per cent. of the cattle were infested as a result of the activity of *A. maculatum* from August to October. One case of infestation was reported from south-eastern Mississippi.

Peterson (A. G.) & Smith (W. W.). **Occurrence and Distribution of Mosquitoes in Mississippi.**—*J. econ. Ent.* **38** no. 3 pp. 378–383, 7 refs. Menasha, Wis., 1945.

Notes are given on the local distribution, abundance and in most cases the breeding places of the mosquitos found in Mississippi, based mainly on recent intensive collecting. The number of species recorded in the State is now 52, all but one of which were included in earlier records [*R.A.E.*, B **32** 194, 195].

Leví-Castillo (R.). *Anopheles pseudopunctipennis* **in the Los Chillos Valley of Ecuador.**—*J. econ. Ent.* **38** no. 3 pp. 385–388, 3 figs. Menasha, Wis., 1945.

The numerous rivers in the Los Chillos Valley of Ecuador, which is situated in the Province of Pichincha, are fed by mountain streams and become swollen during the rainy season but form series of large pools at other times. *Anopheles pseudopunctipennis*, Theo., the only Anopheline in the region and an important vector of malaria, formerly bred in large numbers in these pools, in small ones left in irrigation ditches by the crumbling of the banks, in hoof prints and in the drains of swimming pools. It occurred in all the chief towns of the valley lying between altitudes of about 6,000 and 8,500 ft., but cold air currents and strong adverse winds seemed to have prevented it from establishing itself at Quito, which is at about 9,500 ft. It is stated in a footnote by the editor that the author considers the mosquito in question to be a distinct variety [var. *rivadeneirai*, Leví-Castillo (*R.A.E.*, B **34** 40)]. *Spirogyra* always grew abundantly along the edges of breeding places, and the mosquito was no longer found when the algae were removed. Larvae placed in glasses of water developed normally if *Spirogyra* was provided, but pupated prematurely and produced sub-normal adults or died without completing development if it was not. Cage experiments and collections from houses and occupied tents in the valley showed the females to have a definite preference for human blood. They were plentiful in houses after dark, often engorged and many containing malaria parasites.

The mosquito was originally confined to a restricted area from which it has been spreading gradually, probably for 200 years, with the establishment of towns and settlements. Its spread is aided by the strong winds but hindered by the scarcity of suitable water for breeding, the impossibility of migration in the rainy season and possibly the destruction of adults by heavy rains and of larvae by the flushing of streams. At elevations higher than 8,500 ft., the temperature is too low for the adults in the evening and the water too cold at all times for the larvae, which require water with a temperature ranging from 18 to 20°C. [64·4–68°F.] and a slightly alkaline reaction (pH 7·5–8·5) [*cf. loc. cit.*]. The range of flight of the females was 2–4 miles and that of males not more than 400–500 yards. During the wet season, the females seek shelter in dense foliage and in the numerous caves.

As a result of a campaign carried out under the direction of J. Rivadeneira, *A. pseudopunctipennis* was eradicated from the valley and no new cases of malaria subsequently occurred, so that a region long unsuitable for habitation became prosperous. The main measures used were the draining of pools and the filling of depressions where water tended to collect, supplemented temporarily by the use of oils (crude oil mixed with crank-case oil and kerosene) and other insecticides. Because of the general slope of the ground, drainage was simple and effective, and ditches were in general unnecessary. A permanent inspection system is being maintained. Campaigns for the eradication of *A. pseudopunctipennis* are now in progress in other districts and further ones are planned with the ultimate objective of freeing the whole of the highland country of Ecuador from malaria.

GERBERICH (J. B.). **Quieting Mosquito Larvae.**—*J. econ. Ent.* **38** no. 3 pp. 393–394. Menasha, Wis., 1945.

The author describes the use of a 10 per cent. solution of methyl cellulose in the form of a product known as Methocel to keep mosquito larvae inactive and uninjured while their structures are being examined. One drop of solution is put in the depression of a slide, and the larva with not more than one drop of water is placed on it. The solution and water are then mixed, and the slide is left for 10–20 minutes for the water to evaporate. When the right degree of viscosity is reached, the larva becomes quiescent. It can be left for a considerable period provided that the methyl cellulose is in the gel state, which can be maintained by adding a drop of water periodically. A few living larvae have been kept in the solution for 24 hours in high humidity without apparent injury. When 50 larvae of *Aëdes aegypti*, L., were placed in the solution for three hours each day during the entire developmental period and 50 were kept as controls, all the larvae survived the treatment and there was no appreciable retardation of development. All larvae except one in the test group pupated within 12 days and produced normal adults. The same treatment also proved successful for *Anopheles quadrimaculatus*, Say.

PORTMAN (R. W.) & DALKE (P. D.). **Infestation of a Red Fox by** *Amblyomma americanum*.—*J. econ. Ent.* **38** no. 3 p. 397, 3 refs. Menasha, Wis., 1945.

Small, dark red spots that covered the abdominal region of the inner side of the skin of a red fox received from Missouri in January 1945 were found to consist of 109 nymphs, 36 adults and some larvae of *Amblyomma americanum*, L., which were embedded in the connective tissue. Some were easily distinguishable and others showed only as spots. One female, partly engorged, was found hanging to some fatty tissue and was only a hard robust shell, while all the others were perfectly preserved and entirely flat [*cf. R.A.E.*, B **3** 24; **27** 172 173]. The legs and bodies of the ticks were interwoven with the fibrous connective tissue of the derma. There was no apparent necrotic tissue about any of the ticks, and none of them was enclosed in a nodule [*cf.* **32** 45].

GUNDERSON (H.). **Effect of Cattle Grub Treatment on Weight Gains in Beef Cattle.**—*J. econ. Ent.* **38** no. 3 pp. 398–399. Menasha, Wis., 1945.

The results are given of six tests carried out in Iowa, South Dakota and Kansas in the winters of 1942–43 and 1943–44 in which 219 steers were treated with rotenone in dusts or sprays for the control of *Hypoderma lineatum*, Vill., and *H. bovis*, Deg., and the effect on their weight noted. The cattle had 20–80 warbles each before treatment, and treatments were applied at intervals of a month. The spray consisted of 5 lb. powder containing 5 per cent. rotenone and 10 lb. wettable sulphur per 100 U.S. gals. and was applied twice at pressures of 250–450 lb. The dusts used contained 2·5 per cent. rotenone with wettable sulphur in the first season and 1 per cent. rotenone with pyrophyllite in the second, and were applied two or three times. The animals were weighed before treatment and again 30–90 days later, when it was found that treated animals had gained 0·1–0·42 lb. per day more than similar untreated ones. An increased gain of 0·15 lb. per day is considered important. One lot of cattle treated in January gained 0·42 lb. per day more than untreated ones in the month following the first application of dust, but 0·35 lb. less than untreated ones in the month following the second application. These cattle were from Texas and had probably become infested by November ; the larvae had dropped from the untreated cattle at the time of the second treatment (February).

TELFORD (H. S.) & HARWOOD (P. D.). **DDT fails to remove Horsebots.**—*J. econ. Ent.* **38** no. 3 p. 399. Menasha, Wis., 1945.

A horse in Ohio weighing 1,405 lb. was given 150 gm. DDT in two U.S. quarts ground oats and then placed on light rations of ground oats, lucerne hay and water. No larvae of *Gastrophilus* had been recovered from its droppings after five days. Carbon bisulphide was administered on the sixth day, and eight larvae of *Gastrophilus nasalis*, L., and six of *G. intestinalis*, Deg., were recovered two–three days later. No toxic symptoms followed the ingestion of the DDT.

CARPENTER (S. J.), CHAMBERLAIN (R. W.) & WANAMAKER (J. F.). **New Distribution Records for the Mosquitoes of the southeastern States in 1944.**—*J. econ. Ent.* **38** no. 3 pp. 401–402, 3 refs. Menasha, Wis., 1945.

From January to October 1944, inclusive, 452,782 adult mosquitos and 152,724 larvae (representing in all 58 species) from 138 army installations in the south-eastern United States were identified at the Fourth Service Command Medical Laboratory [*cf. R.A.E.*, B **32** 194]. In the course of the work, 38 new locality records were made, involving 16 species in five genera. These records are given in a table, which also shows the date and method of collection and the number of individuals taken. Seven of the records, involving six species, are new for the States concerned, including one of *Anopheles walkeri*, Theo., one female of which was taken in a light-trap in Alabama.

CARPENTER (S. J.). **Collection Records of *Culex tarsalis* in Army Camps in the southeastern States during 1942, 1943 and 1944.**—*J. econ. Ent.* **38** no. 3 pp. 404–406, 6 refs. Menasha, Wis., 1945.

Culex tarsalis, Coq., is abundant throughout most of the mid-western and western United States and western Canada, where it is active from spring until late autumn. It is found in smaller numbers in the Mississippi Valley and in the eastern States, mostly in late summer and early autumn. In view of its importance in relation to St. Louis and western equine encephalitis [*R.A.E.*, B **33** 80, etc.], records are given of its seasonal and geographical distribution in the south-eastern States as indicated by collections made in army camps in

the Fourth Service Command [*cf.* **32** 194] in 1942, 1943 and 1944. It was found only between late August and early November. The method of collection and number of individuals taken are shown for each record made in 1943 and 1944. The States in which it was found are Alabama, Florida, Georgia, Mississippi, South Carolina and Tennessee.

BARE (O. S.). **Boric Acid as a Stomach Poison for the German Cockroach.**—*J. econ. Ent.* **38** no. 3 p. 407. Menasha, Wis., 1945.

Seven attractive foods and three poisons were tested in Nebraska in 1943 and 1944 in an effort to develop a satisfactory poison bait for *Blattella germanica*, L. In each test, five adult cockroaches and five nymphs of various sizes were placed in each of 15 battery jars with water, food and one of the poison baits. Two tests were also made in which 50–100 cockroaches of all ages were confined in a constant-temperature chamber and provided with an assortment of common foods, water and poison bait. The results of the tests made in the large chamber corresponded closely with those of the jar tests. Butter, honey and powdered confectioners' sugar were the most promising bait materials tried, but none was significantly more attractive than foods often available. Boric acid was the only insecticide tested that was effective and non-repellent at lethal strength. Baits containing sodium fluoride were highly repellent. Borax in baits was not repellent, but its toxicity was very low. Butyric acid, malt extract or stale beer did not significantly increase the attractiveness of the poisoned baits. Baits composed of 10 per cent. powdered boric acid with a mixture of equal parts of honey and butter and with powdered confectioners' sugar gave 80 per cent. kill in nine and 13 days and complete kill in 16 and 21 days, respectively. Nymphs that hatched in the jars containing these baits died in the first instar, whereas those that hatched in control jars developed normally. Both baits were eaten readily even in the presence of common foods, and would be particularly suitable for use where quicker acting and more violent poisons might be dangerous.

TREMBLEY (H. L.). **Laboratory Rearing of** *Aëdes atropalpus*.—*J. econ. Ent.* **38** no. 3 pp. 408–409, 2 refs. Menasha, Wis., 1945.

Continuous rearing of *Aëdes atropalpus*, Coq., in large numbers has been carried out in the laboratory in Maryland since October 1944 by a procedure generally following that described by the author for *A. aegypti*, L. [*R.A.E.*, B **34** 24]. Successful results were obtained with a temperature varying from 74 to 84°F. and 25–100 per cent. relative humidity, but the adults died in a day or two when the relative humidity remained below 60 per cent. and access to water was denied. Emergence, pairing, feeding and oviposition occurred in cages measuring $2 \times 2 \times 2$ ft. and in others measuring $10 \times 10 \times 10$ ins. Sliced apple or dextrose solution was provided as food for the adults and either ground or powdered dog food or whole oats cut in half for the larvae, which were reared in tap water with a pH varying from nearly neutral to 5·5. The water may become foul without apparent injury to the larvae, but a heavy scum covering the whole surface causes death. Oviposition sometimes began two days after a blood-meal, and each female laid about 100 eggs, preferably on water. They hatched in about 24 hours, but would apparently remain viable for at least two months if dried slowly on filter paper soon after deposition. Pupation occurred within 9–14 days, and adults began to emerge about 30 hours later. Females did not engorge readily on blood until they had fed on fruit or dextrose for 10–14 days. They fed with equal readiness on man, chick and white rat, and would engorge completely after as many as four interrupted feeds.

HERMAN (C. M.). *Cephenemyia jellisoni* **Townsend (Diptera Cuterebridae) reared from nasal Bot of Blacktailed Deer.**—*Pan-Pacif. Ent.* **21** no. 3 p. 120. San Francisco, Calif., 1945.

One of three larvae of *Cephenemyia* removed from the nose of a deer (*Odocoileus hemionus*) found dead in northern California in January 1945 pupated and gave rise to an adult after 21–24 days. The adult was identified as *C. jellisoni*, Tns., which is the species recorded by Jellison from the same species of deer in Montana and erroneously identified as *C. pratti*, Hunter [*R.A.E.*, B **23** 268].

LINDQUIST (A. W.), SCHROEDER (H. O.) & KNIPLING (E. F.). **Concentrated Insecticides. Preliminary Studies of the Use of concentrated Sprays against Houseflies and Mosquitoes.**—*Soap* **21** no. 7 pp. 109, 111, 113, 119, 3 refs. New York, N.Y., 1945.

The following is mainly based on the authors' summary. Experiments are recorded showing that atomised sprays of oil containing high concentrations of DDT, pyrethrum extract or both give as good a knock-down and kill of *Musca domestica*, L., and *Anopheles quadrimaculatus*, Say, as those containing low concentrations if the amount of active ingredient applied is the same. The solutions were tested by carrying the insects in small wire-gauze cages into large rooms at various intervals after the discharge of the insecticide and exposing the flies for five minutes and the mosquitos for one minute. DDT at 96·8 mg. per 1,000 cu. ft. was as effective in a 16 per cent. solution as in a 1 per cent. solution. A spray containing 20 per cent. DDT and 2 or 3 per cent. pyrethrins with an auxiliary solvent in kerosene is satisfactory for practical purposes. It is necessary to disperse the solutions in the form of a finely atomised spray. Such a spray was about as effective against flies and mosquitos as an aerosol produced by liquefied gas and applying the same amount of DDT and pyrethrins, and the mortality of flies exposed 30 minutes after the discharge of either aerosol or spray was the same. Preliminary studies indicated that there was little, if any, difference in the size or abundance of the particles deposited on slides by the spray and the aerosol. Models have been made of pocket-sized sprayers that show much promise and weigh considerably less than a one-pound aerosol container or the usual type of household sprayer. An aerosol produced by dichlordifluoromethane (Freon-12) and a concentrated spray dispersed from a pocket-sized capillary-tube sprayer at sub-lethal dosages were equally effective on the basis of mortality of flies and mosquitos, but the aerosol caused a somewhat faster knock-down. The advantages of concentrated sprays are considerable, but the success of their use depends on adequate equipment for dispersing the solutions in a fine mist at a rate that will prevent waste. As little as 0·5 ml. of solution will effectively treat 1,000 cu. ft. of space.

PAPERS NOTICED BY TITLE ONLY.

STIFF jr. (H. A.) & CASTILLO (J. C.). **The Determination of 2, 2-bis (*p*-chlorophenyl)-1, 1, 1-trichloroethane (DDT) in Organs and Body Fluids** [of rabbits] **after oral Administration.**—*J. biol. Chem.* **159** no. 2 pp. 545–548, 3 refs. Baltimore, Md., 1945.

BATT (G. H.). **New Sprayer for testing Aerosols.**—*Soap* **21** no. 7 pp. 117, 119, 2 figs. New York, N.Y., 1945.

STARR (D. F.), BAKER (E. W.) & RAMIREZ (J. A.). **A Dispenser for Methyl Bromide and Methyl Bromide-DDT Aerosols** [for laboratory use].—*J. econ. Ent.* **38** no. 3 p. 401, 1 fig. Menasha, Wis., 1945.

KITZMILLER (J. B.). *Orthopodomyia alba* **in Kentucky.**—*J. econ. Ent.* **38** no. 3 p. 409. Menasha, Wis., 1945.

MARCHIONATTO (J. B.). **Nota sobre algunos hongos entomógenos.** [A Note on certain entomogenous Fungi.]—[*Publ.*] *Inst. Sanid. veg.* (A) **1** no. 8, 11 pp., 1 col. pl., 3 figs., 21 refs. Buenos Aires, 1945.

The entomogenous fungi here recorded from Argentina include *Aspergillus parasiticus* on house-flies [*Musca domestica*, L.] from Entre Ríos and *Empusa americana* on *Lucilia caesar*, L., from Buenos Aires. Infested adults of the latter were found hanging from a branch in masses of over 30.

NETTEL F. (R.). **Onchocercosis. Importancia del xenodiagnóstico y de la investigación de microfilarias en su fase de transición.**—*Medicina* **25** no. 485 pp. 194–203, 12 figs., 6 refs. Mexico, D.F., 1945.

Xenodiagnosis is a useful method of detecting the presence of microfilariae of *Onchocerca volvulus* (*caecutiens*) in man as it is rapid and microfilariae are taken up from deep situations in the skin from which they would not be recovered by superficial biopsy. The procedure followed is to watch for Simuliids alighting to feed and, choosing the easily distinguishable previously unfed ones, cover them individually with test tubes and allow them to complete their blood-meal. When they have done so and entered the tubes, they are killed with chloroform and their stomachs immediately dissected in saline. As many as 250 microfilariae may be found in a single stomach. Only those that have the same form as those taken from the skin in biopsy are taken into account. As it is almost impossible to induce Simuliids to feed in captivity, the method can be used only in endemic areas where they are abundant. In others, deep biopsy and histological methods of study in conjunction with superficial biopsy are necessary to assure recognition of cases. Where xenodiagnosis is practicable, it is suggested that it should be used in conjunction with superficial biopsy. The proboscis of Simuliids and the manner in which they feed are described. The three species of *Simulium* of importance in the transmission of *O. volvulus* in southern Mexico are *S. ochraceum*, Wlk., *S. metallicum*, Bellardi, and *S. callidum*, Dyar & Shannon (*mooseri*, Dampf). The first is of most value for xenodiagnosis, as it is the most abundant and has a decided preference for human blood.

The rate of infestation among Simuliids in a given locality can be determined by dissecting for latent transitional forms (sausage forms) in the thoracic muscles. It is best to use Simuliids collected in the afternoon to avoid including a large proportion of newly emerged individuals. The minimum time required for microfilariae to pass from the stomach to the thorax in *S. ochraceum* in Chiapas was determined as 80 minutes. At the end of this time, they had the same form as those found in the human skin. The morphological changes undergone by the latent forms in 24, 48, 72 and 96 hours are indicated. Out of 631 individuals of *S. ochraceum* dissected from Finca Esperanza, Chiapas, 58 contained latent forms.

Improved Repellents for Protection against Scrub Typhus.—*Bull. U.S. Army med. Dep.* **4** no. 2 pp. 126–127. Washington, D.C., 1945.

Originally, the dimethyl phthalate issued to the United States forces for impregnating clothing to give protection against the Trombiculids that carry tsutsugamushi disease (scrub typhus) required the addition of 2 per cent. soap when the emulsion was prepared [*R.A.E.*, B **34** 147]. To obviate the need for this, an emulsifier was later included in the stock material. Instructions are given for the preparation of the emulsion and the impregnation of garments. Properly treated clothing gives protection against mites between launderings and also against mosquito bites through the fabric for several days and repels other small blood-sucking Diptera, fleas and, to some extent, ticks. Thorough

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treatment withstands sun, rain and sweat. Untreated shorts should be worn under treated uniforms to prevent skin irritation in the groin. Benzyl benzoate and dibutyl phthalate are also effective against mites and are more resistant to removal by washing than dimethyl phthalate [*cf.* **34** 143], which is now being replaced by them. Emulsifiers are incorporated with both. Thorough treatment with them for protection against mites withstands at least two launderings with soap and hot water. They do not repel mosquitos.

West (T. F.) & Campbell (G. A.). **DDT, the synthetic Insecticide.**—$8\frac{3}{4} \times 5\frac{1}{2}$ ins., xii+301 pp., 13 pls., 1 fig., many refs. London, Chapman & Hall, Ltd., 1946. Price 21*s.*

This is a review of the extensive literature on the nature and uses of DDT published up to the autumn of 1945 and is divided into two main parts. The first contains detailed accounts of the research in Switzerland that led to the discovery of the insecticidal properties of DDT, its chemistry and that of related compounds, methods of manufacturing it and applying it in dusts, aqueous suspensions, solutions, emulsions and aerosols, and experiments on its toxicity to man and warm-blooded animals when absorbed in different forms through the skin, by ingestion or by respiration. Investigations on the incorporation of DDT into paints, textiles and paper are described in detail, and tests on other aspects, such as its dispersal as a fog, its action on fish and its fungicidal and repellent effects, more briefly. In the second part, work in various countries on the use of DDT against Arthropods of medical and veterinary importance and insects and other pests of plants and stored products, and on its effect on beneficial insects and plants, is reviewed in detail. A popular account of the development, manufacture and use of DDT during the late war is given in an introduction, and suggestions as to possible future developments in its use in a concluding section. A subject index and an index to the authors referred to are provided.

Ministry of Supply. **Some Properties and Applications of D.D.T.**—34 pp., 38 refs. London, H.M. Stationery Office, 1946. Price 6*d.*

The object of this publication is to summarise information on the practical applications of DDT. It contains a short account of the discovery of the compound and its insecticidal properties and more detailed ones of its physical and chemical properties, the ways in which it is used in solution in organic solvents, in emulsions, suspensions, powders and in aerosols, and as a constituent of paints and distempers, and methods and equipment for applying it.

The results are summarised of investigations on its toxicity to fish, experimental animals, domestic animals and man, which indicate that the danger from DDT is no greater than that from other insecticides such as lead arsenate and nicotine, and may be less, and to Arthropods, chiefly those of medical or veterinary importance. Tables are appended showing some typical formulae for DDT insecticides, and the results of field trials to determine the measure of control by it of various insects, ticks and mites.

Lepage (H. S.) & Giannotti (O.). **Experiências com o D.D.T.** [Experiments with DDT.]—*Biológico* **10** no. 11 pp. 353–366, 1 fig., 4 refs. São Paulo, 1944.

One of the tests described in this paper [*cf. R.A.E.*, A **34** 333] was made with house-flies [*Musca domestica*, L.], and the results obtained with this species in a similar experiment by Wiesmann [B **32** 174] are recapitulated. Filter papers impregnated with 16, 8, 4, 2, 1, 0·5, 0·25 and 0·125 per cent. solutions of DDT in acetone were allowed to dry in a current of air for 48 hours and were then placed in petri dishes with 10 flies. All the flies showed partial paralysis in 20 minutes and death ensued almost at the same time in all the dishes.

DEONIER (C. C.) & BURRELL (R. W.). **Airplane Application of DDT Larvicides.** —*J. econ. Ent.* **38** no. 4 pp. 425–427, 3 refs. Menasha, Wis., 1945.

An account is given of the first part of work in the United States on the application of DDT from aircraft against mosquito larvae, a report of which has already been noticed [*R.A.E.*, B **34** 99]. It concerns the use of dusts, which were not found satisfactory, and the application of sprays from a small aeroplane. An apparatus was devised by C. N. Husman & O. M. Longcoy consisting of a supply tank, a propeller-driven pump and a variable nozzle outlet mounted on a Venturi tube hung beneath the aeroplane at the centre of gravity. In October and November 1943, preliminary tests were made with sprays of 5 per cent. DDT in xylene emulsion or kerosene solution applied with this equipment against natural infestations in central Florida. The solution at 1 U.S. quart or less per acre gave 94·9–100 per cent. control of mosquito larvae, mostly Anophelines, in three areas of vegetated marsh, and both solution and emulsion at 2 U.S. quarts per acre gave complete control of pest mosquitos on open water.

ORR (L. W.) & MOTT (L. O.). **The Effects of DDT administered orally to Cows, Horses, and Sheep.**—*J. econ. Ent.* **38** no. 4 pp. 428–432, 1 ref. Menasha, Wis., 1945.

The following are the authors' conclusions. The results of these tests in which large amounts of DDT were administered to cows, horses, and sheep, as a dry powder or in water suspension, indicate that the chemical is not acutely toxic. Most of the material is evidently eliminated from the body, although small quantities may be taken up by the blood stream. Haemorrhages are frequently produced in the heart and in the lining of the intestines. There is usually a marked loss of appetite, probably associated with the intestinal lesions, which may prove of importance in keeping animals from ingesting large quantities of the chemical over a prolonged period. The nervous system is likely to be affected, although there appears to be a marked variation between species and between individuals of the same species in their susceptibility to effects from the chemical.

There is some indication that individual animals develop a tolerance to DDT, although much additional study is needed on this and other phases of the problem. The effects of DDT dissolved in oils or other organic solvents should be determined, as it is possible that solutions of the chemical would be much more readily assimilated. The results of the present tests do not, however, give reason to expect any bad effects on domestic animals from the proper use of DDT as an insecticide when applied as a dust or in water suspension.

JONES (H. A.), DEONIER (C. C.), BURRELL (R. W.) & KNIPLING (E. F.). **Larvicidal Aerosols containing DDT.**—*J. econ. Ent.* **38** no. 4 pp. 432–433, 2 refs. Menasha, Wis., 1945.

An account is given of tests in Florida of the effectiveness of DDT aerosols produced by liquefied dichlordifluoromethane (Freon-12) or methyl chloride for the control of Anopheline larvae. Auxiliary solvents were used, and fatty acids were added in some tests to increase the non-wettability of the particles. The preliminary tests were carried out in a room with a capacity of 40,000 cu. ft.; the aerosol was released from a nozzle about a foot above the floor and directed towards pans or jars into which larvae of *Anopheles quadrimaculatus*, Say, were subsequently introduced. Releasing 4·05 gm. DDT 60 ft. from a pan killed all the larvae, which were introduced an hour after treatment. Further tests showed that the effect was lasting and that when fatty acids were incorporated in the aerosol, the deposits remained effective after several artificial

rains. Pairs of jars containing water one inch deep were exposed to 6 gm. DDT released 20, 30, 40 and 60 ft. away and allowed to settle for one hour. One jar of each pair was subjected to 6 inches of artificial rain in three minutes immediately after the settling period and in most cases on two subsequent occasions. The other jar was subjected to one similar rain after three days. Six inches of water was siphoned off before each rain after the first. Immediately after the application of artificial rain, larvae were put into all jars. Mortality was complete among all larvae introduced on the day of treatment in all the jars and among all larvae introduced on the third and eighth days in jars up to 40 ft. away, some of which had received two rains. One jar 30 ft. away received a third rain after 17 days, and all larvae introduced immediately and ten days after it were killed. The water siphoned off from the jars just before the rain on the eighth day also gave complete kill. Other tests indicated that if siphoning is repeated before rain tests, the liquid drawn off later is not toxic, although larvae introduced into the jar continue to be killed, presumably by the surface deposit.

In field tests, DDT aerosols applied from the ground gave practically complete kills of Anophelinе larvae at a dosage of 0·1 lb. DDT per acre. The larvae involved in one case were *A. crucians*, Wied. In another, the pond successfully treated had an area of 9,750 sq. ft., and 0·2 lb. pyrethrins per acre applied from a standard pyrethrum aerosol bomb over an area of 1,000 sq. ft. for comparison gave only about 62 per cent. control.

Wisecup (C. B.), Burrell (R. W.) & Deonier (C. C.). **DDT Sprays mechanically dispersed for Control of Anopheline Mosquito Larvae.**—*J. econ. Ent.* **38** no. 4 pp. 434–436, 1 ref. Menasha, Wis., 1945.

The usual methods of applying sprays are not satisfactory for the economical distribution of the small amounts of DDT required for the control of Anopheline larvae, and dispersal by aerosol bombs is not now practicable owing to the scarcity of metal containers and of dichlordifluoromethane (Freon-12). Investigations of alternative methods of distribution showed mechanically dispersed mists to be suitable, and the results are given of tests of these carried out in central Florida on natural breeding places, mostly open ponds and borrow pits containing mixed populations of *Anopheles quadrimaculatus*, Say, and *A. crucians*, Wied. Advantage was taken of any breeze that would drift the mist over the breeding areas parallel with their long axis. Several solvents and types of atomisers were used. A mist containing 5 per cent. DDT in fuel oil applied at 0·1 lb. DDT per acre with a petrol-powered atomiser gave complete control 600 ft. from the point of application, and the same spray at 0·15 lb. DDT per acre, dispersed over nearly seven acres of *Pontederia* swamp from a decontamination spray cylinder, gave perfect control over the whole area (up to 700 ft. from the point of application) except for an occasional live larva at the distant edge. Results were excellent in most of the many other tests, but control fell off beyond 100 and 200 ft., respectively, in two made when wind was very gusty and variable. Mechanically dispersed mists should be of special value in areas where the larvae occur in hoof-prints or other small depressions and would probably also be effective in the outdoor control of adult mosquitos.

Maple (J. D.). **The larvicidal Action of DDT on** *Anopheles quadrimaculatus*.—*J. econ. Ent.* **38** no. 4 pp. 437–439. Menasha, Wis., 1945.

The following is the author's summary. DDT was found to act on larvae of *Anopheles quadrimaculatus*, Say, as a nerve poison, disorganising their movements so that they could not retain contact with the water surface. The toxic dose could be obtained either by contact or by ingestion. Because of the feeding habits of the larvae, a surface application is usually ingested. However, only

a short exposure to DDT in oil solution was toxic by contact. Death resulted from drowning even when sub-lethal dosages were given. Heart action in the posterior of the abdomen was always the last visible sign of life and often did not cease for more than 24 hours after the first tremors appeared.

MATTHYSSE (J. G.). **Grub Control on Dairy Cattle in the Northeast.**—*J. econ. Ent.* **38** no. 4 pp. 442–446. Menasha, Wis., 1945.

The chief loss occasioned by *Hypoderma bovis*, Deg., and *H. lineatum*, Vill., in dairy herds in the northern United States is probably lowered milk production, particularly when the cows are worried by the adult flies. Experiments on control were begun in New York in 1944. Treatment of larvae in the backs of the cattle was restricted to dusting, as this appears to be the only practical method in cold climates. The dusts were applied during the first week of April at 1½–2 oz. per head from shaker jars and worked into the hair by hand. Counts were made seven days later. Neither yam bean [*Pachyrhizus erosus*] nor phenothioxin had any effect. Cubé (containing 4·2 per cent. rotenone) gave 67·2 and 58·4 per cent. mortality in mixtures with wettable sulphur at 1 : 1 and 1 : 3, respectively, and 79·8 and 76·5 per cent. in mixtures with Pyrax ABB (pyrophyllite) in the same proportions. It is concluded that the expense of the stronger concentration is not justified. As the apertures of the cysts of second-instar larvae are often too small for a lethal quantity of dust to enter, a second treatment is necessary. An examination of many of the treated herds a year later showed that there was no significant difference in infestation between them and untreated herds in the neighbourhood.

To demonstrate the value of co-operation and of two treatments, all cattle to be pastured in an area about four sq. miles in extent were treated once in early April and again in early May with the 1 : 3 cubé and pyrophyllite dust. There was a very appreciable decrease in trouble from the adult flies and in the number of larvae a year later. The treatments should be made at intervals of a month with the second as late as possible before the animals are turned out to pasture. Sprays containing DDT in suspensions, solutions or emulsions applied to the legs and undersides of the bodies before the cattle were turned out in the spring with a view to preventing subsequent infestation were of no value. Notes are given on the seasonal activities of *Hypoderma* spp. in New York and on the great variations observed in populations. Because of these variations, it is necessary to use large numbers of animals in all experiments.

EIDE (P. M.), DEONIER (C. C.) & BURRELL (R. W.). **The Toxicity of DDT to certain Forms of aquatic Life.**—*J. econ. Ent.* **38** no. 4 pp. 492–493. Menasha, Wis., 1945.

The following is the authors' summary. DDT in concentrations greater than 0·1 part per million was found to be toxic to goldfish in laboratory tests. In field tests, surface applications of DDT as a dust and in oils were not harmful to fish in dosages used for mosquito control. Other cold-blooded aquatic life, such as frogs, snakes, crayfish, spiders, and insects, were affected by suspensions of DDT. No harmful effects on warm-blooded animals have been noted in applying DDT as larvicidal treatment.

MATTHYSSE (J. G.). **Observations on Housefly Overwintering.**—*J. econ. Ent.* **38** no. 4 pp. 493–494. Menasha, Wis., 1945.

Observations indicated that *Musca domestica*, L., survives the winter in New York State mainly by continuous breeding indoors. It was found to breed in two consecutive winters in dairy barns and in veterinary buildings where stock was quartered and temperature remained above freezing point. In one

dairy barn in the most northerly part of the State in which about 60 head of cattle were housed, flies bred in large numbers throughout both winters in the manure and bedding in box stalls that were cleaned only once every two weeks. The adults were quite active and more abundant in winter than in summer. Nearly all were *M. domestica*, but about 5 per cent. were *Stomoxys calcitrans*, L. Teneral adults were often noticed. House-flies have been seen flying around barns and stables in this part of the State in late March and April. They are as abundant there on warm days in early spring as they are at the same time 200 miles farther south. As the temperature is often well below freezing-point in New York in March, it is not possible that the flies could have migrated so far. At the veterinary College at Cornell University, Ithaca, control measures are often necessary in January. Winter breeding in various agricultural and industrial establishments could easily account for the large populations built up by May and June in the State. Hibernation of any stage does not seem a satisfactory explanation, as the stages would be found in winter or noticed entering or leaving hibernation.

GINSBURG (J. M.). **Toxicity of DDT to subsurface-feeding Species of Mosquitoes.**—*J. econ. Ent.* **38** no. 4 pp. 494–495. Menasha, Wis., 1945.

Laboratory and field experiments were carried out in New Jersey in 1943 and 1944 on the toxicity of DDT to larvae, pupae and emerging adults of several species of *Aëdes* and *Culex*. Fresh larvae and pupae of *C. pipiens*, L., and *A. sollicitans*, Wlk., from natural breeding places were used in the laboratory tests, for which they were placed in dishes containing a mixture of about 80 per cent. tap water and 20 per cent. pond or salt water according to species. A solution of 2 per cent. DDT in ethyl alcohol was used to prepare colloidal suspensions of DDT in water. Oil emulsions contained about 65·5 per cent. kerosene in which various percentages of DDT were dissolved, 34 per cent. water and 0·5 per cent. sodium lauryl sulphate as emulsifier and were diluted before testing with ten parts water and applied at 50 U.S. gals. per acre. Dusts were applied at 0·25–4 lb. DDT per acre and consisted of talc and varying concentrations of DDT incorporated either dry or as solutions in xylene, fuel oil or a light pine oil distillate known as Solvanol No. 1.

DDT in colloidal solution killed all larvae of both species in dilutions up to 1 : 8,000,000. The percentage kill was lower at higher dilutions, but was still over 60 at 1 : 100,000,000. Some pupae survived dilutions higher than 1 : 3,000 and only 31 and 8 per cent. were killed by dilutions of 1 : 80,000 and 1 : 400,000, respectively. Many adults emerged and flew away. DDT in kerosene emulsion killed all larvae at dosages equivalent to 0·084 lb. DDT per acre, but about 0·42 lb. DDT per acre was required to kill all pupae. When applied in a dust, a minimum of 2 lb. dry DDT per acre was required to kill all larvae, but if the DDT was first dissolved, 0·25 lb. per acre, the lowest concentration tested, was sufficient. Apparently the solvents, which are insoluble in water, are released on the surface and produce a toxic film of DDT. Very few pupae were killed and many adults emerged and flew away when even 2 or 4 lb. DDT per acre was applied as a dust, regardless of whether solvents were present or not.

The 32 field tests were carried out on salt- and fresh-water breeding places varying in area from about 40 sq. ft. to two acres. The materials were similar to those used in the laboratory. The subsurface-feeding mosquito larvae seen were *A. sollicitans*, *C. pipiens*, *C. restuans*, Theo., *A. vexans*, Mg., and *C. salinarius*, Coq. Control with dusts applied at 0·5–2 lb. DDT per acre ranged from 20 to 85 per cent. Most of the pupae remained unaffected and developed into adults, many of which flew away. Only in one case, in which a dust containing DDT dissolved in fuel oil was applied at 2 lb. DDT per acre, was complete kill of larvae of *A. sollicitans* obtained. The only emulsion used contained 2 per cent. DDT and was applied at 1–1·6 lb. DDT per acre. It gave complete

control of larvae and pupae in eight out of 14 tests and compared well with 50 U.S. gals. fuel oil per acre. In three of five tests, the duration of effectiveness of one application was about ten days or about the same as that of fuel oil, but in the remaining two it was 3–4 weeks. DDT killed several species of fish, water snakes, turtles, toads and aquatic insects, but caused no injury to aquatic plants or land vegetation near the treated water.

METCALF (R. L.) & WILSON (C. E.). **The residual Toxicity of the Pyrethrins to *Anopheles quadrimaculatus*: preliminary Studies.**—*J. econ. Ent.* **38** no. 4 p. 499, 1 ref. Menasha, Wis., 1945.

A 2 per cent. solution of pyrethrins in kerosene and a 2 per cent. DDT emulsion from a xylene and Triton X-100 concentrate [*cf. R.A.E.*, B **34** 98] were sprayed or brushed on Beaver Board so as to apply 200 mg. pyrethrins or DDT per sq. ft. The toxicities of the deposits as soon as the boards were dry and after ageing for periods of up to 12 weeks were tested by confining batches of 20 or more adults of *Anopheles quadrimaculatus*, Say, under half petri dishes on the boards until knockdown was complete and then placing the mosquitos in gauze cages with cotton-wool soaked in sugar solution, and ascertaining mortality after 24 hours. A surface freshly treated with pyrethrum caused complete knockdown in four or five minutes. The time required increased with ageing until it was 36 minutes after 12 weeks if the surface was exposed to the light or 20 minutes if it was not. Mortality was complete after three weeks' ageing and about 90 per cent. after 12 weeks, irrespective of exposure to light. DDT never caused knockdown in less than 88 minutes, but gave complete mortality after all periods of ageing. Pyrethrins at only 20 mg. per sq. ft. caused knockdown in nine minutes when fresh, in one hour after four weeks and in four hours after eight weeks. A few comparable tests with *Aëdes aegypti*, L., indicated that the two species do not differ greatly in susceptibility to pyrethrins or DDT.

It is concluded that the toxicity of pyrethrum deposits warrants field trials. Through quicker knockdown, pyrethrum would reduce annoyance more than DDT, since mosquitos have been found to feed after an exposure to the latter that eventually kills them. Mortality might be improved by combining pyrethrum with DDT or with activators.

CARPENTER (S. J.). **Packing Mosquito Larvae for Storage or Shipment.**—*J. econ. Ent.* **38** no. 4 p. 501, 1 fig. Menasha, Wis., 1945.

It has been found possible to reduce the proportion of mosquito larvae damaged in transit through evaporation of the preservative or otherwise by packing them in the discarded cartridges used as containers for procaine hydrochloride prepared as a dental anaesthetic. The rubber plug is set in place, the larvae are introduced and the container is completely filled with preservative. To avoid trapping air in the tube, a hypodermic needle is inserted through the rubber stopper so that the opening barely protrudes beyond it, and the stopper is pushed into the tube, the excess preservative escaping through the needle. The needle is then withdrawn. Collection data can be inserted in the open end below the plug.

POSPELOVA-SHTROM (M. V.). **Поспелова-Штром (М. В.). On Certain Groupings within the Genus *Haemaphysalis* C. L. Koch and their taxonomic Significance.** *In Russian.*—*Med. Parasitol.* **14** no. 1 pp. 12–18, 3 figs., 11 refs. Moscow, 1945.

The author discusses the extent to which ticks of the genus *Haemaphysalis* can be divided into groups of allied species on the basis of their morphological characters and certain aspects of their biology. She deals in particular detail

with *H. inermis*, Bir., and *H. warburtoni*, Nutt., the two species for which Schulze erected the genus *Alloceraea*, and concludes that *Alloceraea* should be used as a subgenus of *Haemaphysalis* to include *H. inermis* only. All the other species belong to the subgenus *Haemaphysalis*, *H. warburtoni* being a link between the two subgenera.

[Chumakov (M. P.), Petrova (S. P.) & Sondak (V. A.).] **Чумаков (М. П.), Петрова (С. П.) и Сондак (В. А.). Study of Encephalitis caused by Ultra-viruses. Communication VII. Artificial Adaptation of the Viruses of the Tick-borne and Japanese Encephalitis to different Species of Ticks of the Family Ixodidae.** [In Russian.]—*Med. Parasitol.* **14** no. 1 pp. 18–24, 6 refs. Moscow, 1945.

The ticks used in the experiments described, which were carried out in the laboratory in 1939–41, were *Ixodes ricinus*, L., and species of *Dermacentor*, *Rhipicephalus* and *Hyalomma*, including *H. dromedarii*, Koch, and *H. asiaticum*, Schulze & Schlottke [which are considered by Delpy to be synonymous (*R.A.E.*, B **24** 197)]. They were allowed to feed on laboratory rodents infested with the viruses of spring-summer (tick-borne) encephalitis from man and ticks in the Russian Far East and ticks from White Russia, autumn (mosquito-borne) encephalitis from the Maritime Province [*cf.* **31** 72] or Japanese (mosquito-borne) encephalitis [*cf.* **31** 2, 3] from Tokyo, and the subsequent presence of the virus in them or their offspring was detected by allowing them to feed on healthy mice or by injection into the latter of suspensions of crushed ticks, its identity being confirmed by subinoculation of brain.

The results were inconclusive for *R. sanguineus*, Latr., but the other ticks preserved the viruses with which they were infected for varying periods, the duration of which depended on the conditions under which they were kept. The virus of autumn encephalitis persisted for 13 months in *D. pictus*, Herm.; that of spring-summer encephalitis for 13 days in *R. bursa*, C. & F., 22 days in *R. turanicus*, Pomerantzev, 10½ months in *D. nuttalli*, Olen., 11 months in *H. turkmeniense*, Olen., 12 months in *I. ricinus* and 15 months in *H. asiaticum*; and that of Japanese encephalitis for 14 days in *R. bursa*, 3 months in *I. ricinus* and 25½ months in *H. turkmeniense*. The virus of spring-summer encephalitis was transmitted through the eggs to the larvae of the second generation of *D. nuttalli*, *I. ricinus* and *H. dromedarii*, to the adults of the second generation of *H. turkmeniense*, and to the larvae of the third generation of *H. asiaticum*. *D. pictus* passed the virus of autumn encephalitis to its progeny, and *H. asiaticum* and *H. dromedarii* that of Japanese encephalitis to larvae of the second generation and *H. turkmeniense* to adults of the third. Transmission of the different viruses by the bites of the species of ticks infected with them was obtained in the course of all these experiments except those with the three species of *Rhipicephalus* and the one with *H. turkmeniense* infected with Japanese encephalitis.

All the three viruses were about equally infective to the ticks, and the virulence of the infection in some of them and the long periods for which they preserved it indicated that the viruses were multiplying in them and could become adapted to unusual hosts under natural conditions. The authors consider that spring-summer encephalitis is normally transmitted to man only by *Ixodes ricinus* and *I. persulcatus*, Schulze, but may sometimes be transmitted by other Ixodids that attack man fairly frequently and occur on animals infested by these ticks. Heavy infection of the tick is of primary importance in the transmission of the disease to man. Species, such as *D. silvarum*, Olen., and *Haemaphysalis concinna*, Koch, that are found in foci of encephalitis, possibly help to maintain the virus among wild animals and birds.

[Zvyagintzev (S. N.).] **Звягинцев (С. Н.). Verification of Forecasts of Anopheline Production in newly constructed Reservoirs.** [*In Russian.*]—*Med. Parasitol.* **14** no. 1 pp. 30–36, 6 refs. Moscow, 1945.

Since it is known that the amount of Anopheline breeding that takes place in newly constructed reservoirs depends on the growth of surface vegetation in them, the distribution of such vegetation was studied in a reservoir near Kalinin in 1937–39 [*cf. R.A.E.*, B **31** 108] and further surveys, an account of which is given, were made in 1939–40 to verify the conclusions drawn. The areas covered by plants that favour breeding were plotted on a map and compared with their previously expected distribution, and as far as possible the actual presence of larvae of *Anopheles* [*maculipennis*, Mg.] was correlated with vegetation. This was not possible in all areas, since control measures had been applied in some of them. It was found that vegetation growing in shallow water near the banks and in other protected places was the most important, and that isolated patches further out were unfavourable, except when the water level fell to such an extent that these became united to the peripheral growths. In general the forecast was fairly accurate. Some discrepancies were observed, and their causes are discussed at length. It was found essential to take into consideration numerous factors that influence the development and spread of the vegetation, such as the relief of the site, the depth of flooding, existing terrestrial plant communities, conditions that favour or inhibit the introduction of aquatic plants, the nature of the bed of the reservoir and of the adjoining soil, and the direction of the prevailing winds.

[Ananyan (S. A.), Chubkova (A. I.), Azizyan (A. A.) & Kocharyan (A. A.).] **Ананян (С. А.), Чубкова (А. И.), Азизян (А. А.) и Кочарян (А. А.). Interrupted Irrigation of Rice Plantations as a prophylactic and agrotechnical Measure of controlling Malaria in the Armenian SSR.** [*In Russian.*]—*Med. Parasitol.* **14** no. 1 pp. 36–45, 3 figs. Moscow, 1945.

Though periodic draining of rice-fields gave good control of Anopheline larvae in Azerbaijan and Armenia in 1926–28 [*R.A.E.*, B **17** 7, 117], this measure was not generally adopted, and further experiments were therefore carried out in 1942 in a rice-growing area in the valley of Ararat in Armenia. The temperature and relative humidity of the air during the vegetation period averaged 20·5°C. [68·9°F.] and 51 per cent., and the rainfall totalled about 4 ins. Anopheline larvae occurred in the rice-fields from the beginning of June to the end of August, but an irrigation ditch, a quarry, a temporary pool and seepage water from a rice-field became the chief breeding places after the rice grew tall and shaded the surface of the water. The larvae found in the rice-fields comprised *Anopheles maculipennis*, Mg., *A. hyrcanus*, Pall., and *A. superpictus*, Grassi; *A. maculipennis*, which is the chief local vector of malaria, was the most abundant, and *A. superpictus* was scarce.

The experimental plots were flooded on 6th–7th June and drained for the first time on 26th June, when third-instar larvae were present and the rice was tillering. They were flooded again after four, five or six days, and the process was repeated thereafter at intervals of eight or twelve days. The plants began to wither towards the end of each period of draining, but revived when irrigated. The crop was harvested on 16th October. The best results were given by draining the fields for five days at intervals of eight days, since in comparison with undrained control plots, the reduction in yield was very slight and the reduction in Anopheline production was 99·6 per cent. Many larvae survived when the period of drainage was reduced to four days, and the yield of rice was much reduced when it was increased to six, doubtless owing to the excessive growth of weeds. When the period of flooding was increased to 12 days, some larvae were able to complete their development during the first 2–3 days of

draining in hot weather. The effectiveness of the method is much increased by levelling the soil, but the destruction of weeds during the period of drainage is essential for a good rice yield. At the beginning of the vegetation period, the fields can be flooded for a longer period, since the cooler weather retards the development of the mosquitos.

[Tiburskaya (N. A.).] **Тибурская (Н. А.). Further Observations on the gamostatic Action of Plasmocide in combined Treatment of Malaria.** [*In Russian.*]—*Med. Parasitol.* **14** no. 1 pp. 64–75. Moscow, 1945.

Investigations on the combined treatment of malaria patients with plasmocide and acrichin to render them non-effective to mosquitos were continued in Samarkand on the lines of previous experiments [*cf. R.A.E.*, B **26** 72]; 19 of the patients had gametocytes of *Plasmodium vivax* in the peripheral blood and four had those of *P. falciparum*. Females of *Anopheles maculipennis*, Mg., bred in the laboratory were allowed to feed on them before the administration of the drugs and 24 and 48, and in some cases 72 and 96, hours after treatment had begun, and were examined for oöcysts 6–14 days later, a total of 2,731 individuals being dissected. The results are shown in tables and discussed.

In 9 of 10 similar tests in 1941, treatment for five days with a daily dose of 0·06 gm. plasmocide combined with one of 0·3 gm. acrichin prevented the infection of the mosquitoes with *P. vivax* after 24 hours, and in the investigations described, treatment for four days with plasmocide at a daily dose of 0·04 gm. and acrichin at a total dose of 0·5 gm. during the first day and a single daily dose of 0·3 gm. during the next three days was effective in the majority of cases. Among mosquitos that fed 24 and 48 hours after the beginning of treatment, the proportions that became infected were reduced by over 75 and over 98 per cent., respectively, as compared with those that fed before treatment, and the reductions in the number of oöcysts present in infected examples were even greater.

None of the four cases of *P. falciparum* infected mosquitos after treatment, though all did so before. Three of them received the same doses of the drugs as those infected with *P. vivax* and the other was treated for two days with plasmocide at a daily dose of 0·03 gm. and acrichin at a daily dose of 0·2 gm.

[Solodovnikova (O. I.).] **Солодовникова (О. И.). The Effect of Acridine No. 8 and Acrichin on the Infection of the Mosquitos** *A. maculipennis sacharovi* **with Parasites of tropical Malaria.** [*In Russian.*]—*Med. Parasitol.* **14** no. 1 pp. 75–78. Moscow, 1945.

An account is given of experiments in Samarkand in which neither acrichin nor acridin No. 8, synthetic drugs that destroy the schizonts of the three malaria parasites, rendered patients suffering from tropical malaria [*Plasmodium falciparum*] uninfective to *Anopheles maculipennis* var. *sacharovi*, Favr. It is recommended, therefore, that plasmocide, which acts on the gametocytes, [*cf.* preceding abstract] should also be administered.

[Shishlyaeva-Matova (Z. S.).] **Шишляева-Матова (З. С.). Contribution to the differential Diagnosis of the different Species of Malaria Plasmodia by the Oöcysts.** [*In Russian.*]—*Med. Parasitol.* **14** no. 1 pp. 78–85, 5 figs., 11 refs. Moscow, 1945.

The author reviews the work of James, Nicol & Shute [*R.A.E.*, B **22** 18] and earlier authors on the differentiation of the oöcysts of *Plasmodium* spp. by means of the character and arrangement of the pigment, and states that oöcysts of *P. vivax* and *P. falciparum* observed in mosquitos in Uzbekistan in 1938 did not agree with the published descriptions, which are themselves

somewhat contradictory. She therefore examined the stomachs of females of *Anopheles maculipennis* var. *sacharovi*, Favr, of which 109 bore oöcysts of *P. vivax* and 137 bore those of *P. falciparum*. The results, which are described in some detail, showed that the arrangement of the pigment altered and its colour usually became fainter in oöcysts of both species as they developed, and the presence of black pigment in those of *P. falciparum* was not constant, so that the two species could not be distinguished on the basis of these characters.

It is stated in a footnote by the Russian editor that these results are not conclusive, since no account was taken of the refractive capacity of the envelope of the oöcysts of *P. falciparum*.

[Polumordvinov (A. D.).] **Полумордвинов (А. Д.). Highland Malaria in southern Tadzhikistan.** [*In Russian.*]—*Med. Parasitol.* **14** no. 2 pp. 18–20. Moscow, 1945.

Surveys carried out in October in 1932 and 1942 in two groups of villages in Tadzhikistan showed that malaria occurred in both of them, though they were at an altitude of 7,200-9,350 ft. In one group, the disease was locally acquired. Possible Anopheline breeding places consisted of a few irrigation ditches, comparatively large areas flooded by a river, and a few springs suitable only for a species such as *Anopheles claviger*, Mg. (*bifurcatus*, auct.). No Anopheline larvae were found in either year and, probably owing to the surveys being in October, the only adult observed was a female of *A. superpictus*, Grassi, taken in a cow-shed in 1932. In the other group, the malaria was mostly introduced, and breeding places were uncommon, but a few springs contained larvae of *A. claviger*, and adults of this species were taken in day-time shelters. *A. superpictus* was found in a valley at an altitude of 6,890 ft.

[Vinogradskaya (O. N.).] **Виноградская (О. Н.). Resistance to Dryness and Moisture Requirements in different Species of *Anopheles*.** [*In Russian.*]—*Med. Parasitol.* **14** no. 2 pp. 28–37, 2 graphs, 13 refs. Moscow, 1945.

The resistance to atmospheric dryness of females of species of *Anopheles* that occur in the Russian Union was studied in the laboratory by exposing batches of up to 40 individuals for various periods to known saturation deficiencies at constant [though unstated] temperature. Most of the tests were carried out with *A. superpictus*, Grassi, with an exposure of 48 hours. The resultant mortalities of this species are compared on a graph, from which it is apparent that when given a blood-meal and water to drink, newly emerged females were more resistant to dryness than those taken in day-time shelters. Females not given a blood-meal were less resistant, and those given neither water nor blood least so, females from day-time shelters being the more resistant in both these cases. The tendency of *A. superpictus* to avoid excessive dryness or humidity was shown in experiments in which females taken in day-time shelters were placed in a muslin cage of which one third was covered with wet towels and, to ensure uniform conditions of light, the remainder was covered with dry towels. The temperature and relative humidity ranged from 24 to 28° C. [75·2–82·4 F.] and 92 to 60 per cent. in the moist part of the cage, and from 25 to 30° C. [77–86 F.] and 81 to 37 per cent. in the drier part. Most of the mosquitos congregated in the drier part, but when the relative humidity dropped to 37 per cent. the majority moved to the moist part.

From a comparison of the mortality of several species of *Anopheles* kept under various conditions of dryness for periods that varied from 40 minutes to 35 hours, it is concluded that *A. pulcherrimus*, Theo., is the most resistant, followed in order of decreasing resistance by *A. superpictus*, *A. hyrcanus*, Pall., *A. maculipennis*, Mg., var. *atroparvus*, van Thiel, and *A. m. messeae*, Fini. The causes of the difference in resistance to dryness of these and two other

species were studied with special reference to the effect of saturation deficiency on the osmotic pressure of the haemolymph, the loss in weight due to evaporation of water from the body, and the spiracle index [*cf. R.A.E.*, B **31** 188]. It is concluded from this work, which is discussed in some detail, that of the species that occur in the south of the Russian Union, *A. superpictus* and *A. pulcherrimus* are resistant and *A. algeriensis*, Theo., and *A. claviger*, Mg. (*bifurcatus*, auct.) are not. *A. superpictus* and *A. pulcherrimus* have small thoracic spiracles, whereas *A. algeriensis* and *A. claviger* have large ones and so lose much more water by evaporation through the tracheal system under dry conditions. It also appears that *A. superpictus* can maintain the osmotic pressure of the haemolymph at a constant level, possibly by eliminating salts through the malpighian tubes. *A. pulcherrimus* loses less water, but cannot regulate the osmotic pressure of the haemolymph so well. *A. hyrcanus*, which is known to be relatively hygrophilous, proved moderately sensitive to dry conditions ; it has large spiracles and showed little ability to regulate the osmotic pressure of the haemolymph. Of the two northern forms, *A. m. atroparvus* was more resistant to dryness than *A. m. messeae*, and this is attributed to the smaller percentage of water in its body and its smaller thoracic spiracles.

[Detinova (T. S.).] **Детинова (Т. С.). Determination of the physiological Age of the Females of *Anopheles* by the Changes in the tracheal System of the Ovaries.** [*In Russian.*]—*Med. Parasitol.* **14** no. 2 pp. 45–49, 2 figs. Moscow, 1945.

Previous methods of determining the physiological age of female mosquitos [*cf. R.A.E.*, B **20** 280 ; **21** 71] do not permit young females that have oviposited to be distinguished with certainty from those that have not. As the matter is of importance in relation to malaria control, the author has evolved a reliable method based on the tracheal system of the ovaries. She observed in the course of investigations on *Aëdes* in 1940, that this system undergoes a series of essential changes during the development of the eggs, and later confirmed it in the case of *Anopheles maculipennis*, Mg., var. *messeae*, Flni. When the ovaries are isolated in a drop of water and allowed to dry, the tracheal system gradually fills with air and becomes visible on the surface. Saline should not be used, because a deposit of salt forms on the drying ovary and obliterates the tracheae. The distribution of the tracheae in the ovaries is described. Newly emerged females of *A. m. messeae* are characterised by the presence of minute nodules at the tips of these tracheae. These nodules consist of the tightly rolled filaments of the tracheoles and may be spherical or elongated ; they are situated among the follicles or directly on their walls, and become visible when the ovaries have dried. One or two terminal filaments extend from each nodule and penetrate still deeper among the follicles. The thicker branches of the tracheae in the ovary are arranged in loops and zigzags that will enable them to extend over the ovary as it grows. The nodules and the terminal filaments do not change their size during the early stages of ovarian development, including stage II of Christophers [*cf.* **25** 37]. After the ingestion of blood and with the growth of the ovaries, changes in the tracheal system begin, and dissection of females during the day following oviposition showed that the nodules and large loops on the tracheal branches had been replaced by a dense net of tracheolar filaments that penetrated the entire ovary. The unrolling of the nodules cannot apparently be reversed. Occasionally, 1–4 nodules were still present after the first batch of eggs was laid, but none remained after the deposition of the second batch.

It is pointed out that this method can be of value in summer in ascertaining the percentage of newly emerged females in a mosquito population and hence

the effectiveness of control measures, in autumn in estimating sexual activity in the last generation of the season, and in winter in ascertaining the composition of the hibernating population. Thus, of the females of *A. m. messeae* taken in December 1943 and January 1944 in a peat district in the Province of Moscow, 14·5 per cent. had a dense net of tracheoles in the ovaries and no nodules, whereas no females of this type were found in February or March. This indicated that some females that had oviposited enter hibernation but die during the early winter.

[Zolotarev (E. Kh.).] **Золотарев (Е. Х.). *Anopheles maculipennis* of North Iran.** [*In Russian.*]—*Med. Parasitol.* **14** no. 2 pp. 50–57, 1 map, 4 refs. Moscow, 1945.

Anopheles maculipennis, Mg., is known to occur on the mountain plateau of northern Persia and to be associated with severe malaria in the lowlands along the Caspian Sea [*R.A.E.*, B **33** 16]. Potential breeding places are numerous in the humid coastal zone, where they include rice-fields, irrigation ditches, swamps, the mouths of rivers, and reservoirs in and near villages, but breeding on the plateau, which is situated at a height of about 4,000–5,000 ft. and has a dry continental climate, appears to be confined to water from mountain streams and defective irrigation ditches.

In 1944, about 1,000 batches of eggs laid by females collected in various areas were examined to ascertain the identity and distribution of the varieties present. Those found along the coast of the Caspian were var. *typicus*, which occurred in the foothills of the Elburz range to the south, and of the Taluish and Bagrov-Dagh ranges to the west, and in the coastal strip between these and the sea; var. *subalpinus*, Hackett & Lewis, which was common in the wider maritime plains in the south and in rice-fields in some districts, though not in others; and var. *sacharovi*, Favr, which occurred only in the steppe zone to the east and bred in fairly saline water. The only variety found on the plateau was var. *typicus*; it was common in the north-west and fairly so in river valleys and forests in the central and eastern parts, but rare or absent in the north-east. In the eastern district it was most numerous in spring and early summer, after which it was replaced by *A. superpictus*, Grassi. The latter also predominated in the gorges of the central Elburz, where *A. claviger*, Mg. (*bifurcatus*, auct.) frequently occurred in autumn.

[Dobrosmislov (D. I.).] **Добросмыслов (Д. И.). Thiodiphenylamine as a Substitute for existing Larvicides in the Control of Mosquito Larvae.** [*In Russian.*]—*Med. Parasitol.* **14** no. 2 pp. 57–62, 5 refs. Moscow, 1945.

Field experiments to compare the effectiveness of dusts of phenothiazine (thiodiphenylamine) and Paris green for the control of larvae of *Anopheles maculipennis*, Mg., were continued near Moscow in 1940 [*cf. R.A.E.*, B **31** 161]. Both materials were finely ground and mixed with road dust, and both gave complete mortality of larvae of the second, third and fourth instars in 24 hours in 5 out of 6 tests when applied at the rate of 0·9 lb. per acre, there being little or no mortality in untreated water. When the rate of application was reduced to 0·72 lb. per acre, phenothiazine gave 99·1 and 97·1 per cent. mortality in two experiments, while Paris green gave 100 per cent. To test how long the materials would remain on the surface of water, 100 mg. of each was dusted on to water in containers with a diameter of about $8\frac{3}{4}$ ins.; the amounts still on the surface 18 and 24 hours later were 57·7 and 37·5 mg. Paris green and 70 and 64·3 mg. phenothiazine.

Suspensions of phenothiazine were tested as a substitute for oil for control of larvae of various genera. In the laboratory, suspensions containing 1–2 oz. phenothiazine and 0·3–0·5 oz. soap in 10–12·5 pints water, applied at a rate equivalent to 0·9 lb. phenothiazine per acre, killed all the larvae of *Anopheles* and *Culex* in 18 hours at a water temperature of 16–17°C. [about 61°F.]. In the field, complete mortality of larvae of *Anopheles*, *Culex* and *Aëdes* was obtained in 6–8 hours provided that the amount of phenothiazine applied per acre in the suspension was increased to 2·7–3·6 lb. Even at this rate of application, the cost was considerably less than that of oiling, and it is thought that it would not be higher than that of Paris green.

[Nikol'skiĭ (A. L.).] **Никольский (А. Л.). Rational Preparation of Kizyak as a Means of Controlling Flies.** [*In Russian.*]—*Med. Parasitol.* **14** no. 2 pp. 70–72. Moscow, 1945.

Sun-dried cakes or bricks of cow dung (kizyak) are widely used as fuel in Ferghana (Uzbekistan), and observations were carried out to ascertain whether flies can breed in them while they are being dried. The results showed that there was little risk of this, provided that the cakes were not more than 8 cm. thick, that they were prepared from dung not more than five days old and that they were turned repeatedly during the few days required for drying. Cakes up to 10 cm. thick remained moist for several weeks ; numerous fly larvae developed in them and some were observed leaving them in search of sites for pupation.

[Rubinshteĭn (B. B.).] **Рубинштейн (Б. Б.). Sweet-rush (*Acorus calamus* L.)—a new antipediculous Substance.** [*In Russian.*]—*Med. Parasitol.* **14** no. 2 pp. 72–73. Moscow, 1945.

Tests were carried out in 1943 on the value of the powdered rhizomes of *Acorus calamus* [*cf. R.A.E.*, B **32** 223, etc.] against lice [*Pediculus humanus*, L.]. This plant is common on marshes and along rivers in central European Russia, and the experimental material was taken from a river to the south-west of Moscow. The air-dried rhizomes were found to contain 1·3 per cent. essential oils and 0·62 per cent. of an alkaloid called calamine that possibly acts as a contact poison. The powder was applied to lice on pieces of fabric in covered glass containers kept at 26 or 37°C. [78·8 or 98·6°F.] ; the lice became restless in 1–2 hours, then torpid, and died in 4–7 hours or more. The powder proved less toxic than pyrethrum powder, but a little more so than SK dust [*cf.* **32** 5], the periods for 50 and 100 per cent. mortality being 5–7 and 6–13 hours for *Acorus*, 2–7 and 6–11 hours for pyrethrum and 5–9 and 6–14 hours for SK, at 37°C. The dosages used are not stated. At 26°C., the insecticidal action of all three materials was slower, but their effectiveness was in the same order. Powder made of dried leaves of *Acorus* was less toxic than that made of the rhizomes.

[Komarova (M. I.).] **Комарова (М. И.). Pyridine Bases as a Means of Controlling Lice.** [*In Russian.*]—*Med. Parasitol.* **14** no. 2 p. 74. Moscow, 1945.

In experiments with pyridine bases (a mixture of pyridine and its homologues) very weak solutions killed all head lice [*Pediculus humanus capitis*, Deg.] and their eggs in test tubes, and a 30–40 per cent. solution killed all those on infested heads when the hair was kept wetted with the liquid for 30 minutes. Special tests showed that pyridine bases are harmless to the human hair and skin.

All body lice [*P. h. humanus*, L.] and their eggs were killed when infested clothes were exposed for two hours at room temperature (about 75°C. [59°F.]) in a tank to the vapours of pyridine bases, the evaporating surface being 12 sq. ins. per 1,000 cu. ins. space. The clothes were not damaged.

[Tarabukhin (I. A.) & Vanshtok (A. P.).] Тарабухин (И. А.) и Ваншток (А. П.) **The Justification for Dusting from Aircraft on the Bank opposite to a populated Locality situated on a large River.** [*In Russian.*]—*Med. Parasitol.* **14** no. 2 pp. 75–76, 1 map. Moscow, 1945.

The experiments described were carried out in the summer of 1942 to ascertain whether the mosquitos that occur in a health resort on the right bank of the Ob, in the Province of Novosibirsk, fly across from the flooded left bank, where dusting from aircraft has been carried out for several years for the control of Anopheline larvae. Over 5,000 adults of *Anopheles maculipennis*, Mg., were collected, stained and released on the left bank on various dates and catches were subsequently made at two places on the right bank at distances of about 1 and 2½ miles from the point of release and one on the left bank 3 miles downstream. Five of the stained mosquitos were recovered, three in houses at the nearer point on the right bank and the other two in animal quarters at the place on the left bank. It is concluded that mosquitos cross the Ob in this district and that dusting the flooded area is justified.

[Artemenko (V. D.).] Артеменко (В. Д.). **Data on the Distribution of *Phlebotomus* in the South of the Ukraine. Communication III.** [*In Russian.*] — *Med. Parasitol.* **14** no. 2 p. 77. Moscow, 1945.

Further data are given on the distribution of *Phlebotomus* spp. in the southern Ukraine (*cf. R.A.E.*, B **28** 38) based on catches in 1940. Those taken were *P. chinensis*, Newst., the aberrant form of *P. sergenti*, Parr., previously recorded (**28** 39), and a single male of *P. papatasii* Scop., which had not previously been reported from the Ukraine.

[Latyshev (N. I.).] Латышев (Н. И.). **Instructions on the Methods of Testing chemical Means of Protection from the Bites of Sandflies.** [*In Russian.*] — *Med. Parasitol.* **14** no. 2 pp. 82–85, 9 refs. Moscow, 1945.

This is a discussion of methods that can be employed to obtain personal protection from sandflies (*Phlebotomus*). Mosquito nets are widely used in the Russian Union, but are frequently of too wide a mesh to exclude sandflies and in this case some repellent substance should be applied to the skin or clothes or to the nets themselves. The author outlines methods of testing repellents, enumerates the properties that they should possess, cites suggested formulae from the literature, and states that encouraging results have been obtained in experiments against sandflies with dixanthogen (bisethylxanthogen), which is known as preparation K (*cf. R.A.E.*, B **31** 227, 228, etc.) and was used at a concentration of 3–5 per cent. in vaseline.

Milne (A.). **The Control of the Sheep-tick (*Ixodes ricinus* L.) by Treatment of Farm Stock.**—*Ann. appl. Biol.* **32** no. 2 pp. 128–142, 29 refs. London, 1945.

The following is based on the author's summary. In Britain, *Ixodes ricinus*, L., is almost confined to rough hill grazing land, where its chief domestic hosts are sheep and cattle (*R.A.E.*, B **32** 232). The difficulties involved in treating cattle, sheep and lambs for its control are described. Dipping is the most efficient method for sheep. To be satisfactory, a dip must be safe, easily mixed, fairly inexpensive and capable of dealing with most of the ecto-parasites present and must have a lasting effect. No experimental dip tested has surpassed a commercial preparation of sodium arsenite and derris containing, when diluted, 0·19 per cent. arsenic (as As_2O_3), 0·08 per cent. ground derris root, 0·26 per cent. tar oils and tar acids and 0·82 per cent. wool grease (*cf.* **25** 219). Immersion for 30 seconds in this dip kills all female ticks and keeps the sheep free for 7–10

days. Reinfestation is not complete for 3–4 weeks. The residual effect is chiefly attributable to the derris. Unlike arsenic, derris kills some ticks before they attach and thus lessens tick-worry and the chances of the transmission of disease. When 200–300 sheep were dipped, they added a large quantity of solid matter to the bath. They finally carried away about ½ gal. dipping fluid each in their fleeces. The arsenic content of the dip remained unchanged, but the derris content was reduced, probably because the particles of ground root were retained in the meshes of the fleece as excess fluid ran back to the bath. The surface tension of the bath increased from about 48 to 50 dynes per cm. Residual protection lessens as dipping progresses. The wool grease prolongs the effect of sodium arsenite, although the amount acquired cannot be more than 10–17 per cent. of that already in the fleece. Since *Psoroptes ovis*, Hering, is controlled by arsenic and *Melophagus ovinus*, L., and *Damalinia* (*Trichodectes*) *ovis*, L., by derris, the dip will control all these parasites, provided that the double dipping necessary against them is done, but it is not effective against blowfly larvae.

Light smearing with vaseline or wool grease kills attached female ticks within 24 hours, but sprays and smears are useless for sheep because they do not successfully penetrate the long wool among which many of the female ticks are attached. A dust of derris and Fuller's earth (13 : 37) was as effective against ticks as the dip, but is difficult to disperse in wooled areas. Moreover, derris dusts sometimes severely affected the eyes of the sheep, often blinding them for several weeks, even though the ear was folded over the eye during dusting. For sheep, the dip is superior to any known dust.

Lambs less than 4–6 weeks old cannot be dipped and must be treated on the pasture. A dust of derris and Fuller's earth, which gave protection of a similar order to the dip on sheep, is preferable to a derris smear because it is cleaner to apply, does not cause scalding and never makes a ewe forsake her lamb. Among thousands of lambs dusted, very much less than 1 per cent. had their eyes affected.

Cattle can be washed or dusted in stalls if used to handling, or jetted in stocks if not, except for the most dangerous kinds. Of several derris dusts, washes and jetting fluids, the best was one composed of ½ lb. ground derris root, 4 oz. soap and 8 pints water, which gave protection of the same order as the dip on sheep, and was also effective against warbles [*Hypoderma*]. Cubé (*Lonchocarpus*) root of similar rotenone content to derris root gave similar results in the dip for sheep, dust for lambs and wash for cattle.

Attempts have been made to reduce tick populations on grazing land by periodical treatment of stock. To achieve this, it would be necessary to repeat treatment with materials containing derris every 2–3 weeks. The prevention of dipping for about six weeks by lambing allows about half of the female ticks to escape and breed on the normal sheep farm in spring. The duration of protection would have to be lengthened to 5–6 weeks to prevent this escape. Research work designed to show whether the duration of residual protection could be increased and if so how this could be done is suggested.

ASCHNER (M.) & MAGER (J.). **Evaluation of Materials for Louse Control.**—*Ann. appl. Biol.* **32** no. 2 pp. 143–148, 3 graphs, 3 refs. London, 1945.

The shortest time in which liquid contact insecticides could give complete kill of *Pediculus humanus humanus*, L. (*P. h. corporis*, Deg.) at a given concentration was ascertained by immersing batches of 5–10 lice in different dilutions of the substance for 1–60 minutes. At the end of exposure, the lice were immediately placed on blotting paper and the adhering liquid was removed by blotting. For shorter contacts, five lice were put on a flat glass plate and the liquid was dropped on to them so as to enclose the whole batch. After exposure, the batch was swept with blotting paper on to a larger sheet and the liquid was

removed from them. Solid contact poisons were spread on cloth or filter paper or the skin of volunteers and the lice were allowed to crawl over them. Fumigants were evaluated in hermetically closed glass containers in which the test substance evaporated from a small piece of blotting paper at some distance from the lice. The various contact insecticides tested fell into two groups, those equally effective against adults and nymphs of all instars (such as pyrethrum, ethyl alcohol and creosote) and those that were more effective against adults. Butanol required 12 times as long to kill first-instar nymphs as adults and kerosene 60 times as long. No difference in susceptibility between nymphs and adults was observed in fumigation with acetaldehyde, chloroform, ether, ethylene dibromide or ethylene dichloride. Eggs were more resistant to fumigants and contact poisons than the other stages, but increased in susceptibility as they developed.

If two insecticides are applied simultaneously, they may show an intensified or diminished effect or no interaction at all. Both 1 per cent. pyrin (a pyrethrum extract containing isobutylundecyleneamide as activator) and 1 per cent. creosote in kerosene kill first-instar nymphs with an exposure of two minutes, and a mixture containing 1 per cent. of each kills them in one minute. A 4 per cent. solution of creosote in kerosene is lethal after 0·5 minute, but the same concentration in alcohol or in 1 per cent. aqueous sodium taurocholate is ineffective even after eight minutes, though the minimum lethal time of exposure for kerosene is 60 minutes. Similarly, butanol kills the first-instar nymphs in eight minutes when undiluted and in two minutes when diluted with kerosene (1 : 12). The addition of a sublethal dose of ethylene dichloride to a minimum lethal concentration of ethylene dibromide reduces the activity of the latter so that the lice remain alive, probably by causing paralysis and so lowering the respiration rate and decreasing the amount of fumigant taken up. In experiments carried out to determine the ratio of length of exposure to effective concentration, striking differences were found between the behaviour of pyrin and that of creosote or butanol. When the dilutions were made in kerosene and minimum exposure times were plotted against the reciprocal value of the lethal concentrations, creosote and butanol gave a straight line for complete kill within certain limits of concentration and time, but the action of pyrin was much more complicated. Practically the same time was required at 2 and 4 per cent., but from 2 per cent. downwards the necessary exposure increased very rapidly with decreasing concentration. Pyrethrum has a very large zone of partial effect, but creosote and butanol have practically none.

Insecticides are generally more active if applied in liquids than in powders or ointments. If a louse crawls on filter paper covered with a thick layer of talcum powder containing 4 per cent. creosote, its whole surface becomes dusted and eight minutes' exposure is enough to kill it, but if the layer of insecticide is thin, only the tips of the legs and some parts of the head come into contact with it and there may be no effect, even after long exposure. Pyrin remains effective under these conditions. The minimum lethal exposure times are given for several liquids, solids and fumigants. Those giving complete kill with exposures of two minutes or less were undiluted pyrin, ethylene dibromide, creosote, carbon tetrachloride, guaiacol and 95 per cent. acetaldehyde in the first group, undiluted DDT in the second, and ethylene dibromide in the third. Apart from the necessary exposure time, one of the chief considerations in choosing an insecticide is the time that the louse survives after exposure. Pyrethrum is superior to DDT in this respect. Ethylene dibromide as a fumigant is convenient and practical for eradicating lice from a community already infested. At 4 mg. per litre, it is lethal with an exposure of eight minutes, is not irritant to man, can be handled without special precaution and has no deleterious effect on clothing. Owing to its low vapour pressure, it can be applied in containers not hermetically closed. It was effectively used in a labour camp to fumigate clothes in barrels, by spraying it on to each layer of

clothing as it was put in and using about 10 cc. per 200 litres [1 fl. oz. per 125 gals.] for half an hour's exposure. The barrel was rolled slowly to ensure access of the fumigant to all parts of the clothing. A disadvantage of the method is that the lice may survive for 24 hours and feed after exposure. Several of the solids tested can be used for impregnating clothing by soaking the clothes in a solution in an organic solvent for several minutes and then drying them. For this purpose, 0·05 per cent. DDT is sufficient, but 2 per cent. 4-bromdiphenyl and 5 per cent. diphenylamine are necessary. Parabromaniline has the advantage of producing rather quick stupefaction of the lice.

GNADINGER (C. B.). **Pyrethrum Flowers. Supplement to second Edition 1936–1945.**—9¼×6 ins., pp. xiv, 381–690, 40 figs., 1,373 refs. Minneapolis, Minn., McLaughlin Gormley King Co., 1945.

This supplement to the second edition of a work already noticed [*R.A.E.*, B **24** 214] incorporates the considerable data on the production and insecticidal uses of pyrethrum that have accumulated since the publication of that edition in 1936. The pagination is continuous with that of the second edition, the subject matter is arranged under the same chapter headings, and a complete index to both volumes is provided. The subjects dealt with at greatest length are the commercial sources of pyrethrum and biological methods for its evaluation (pp. 455–503); other chapters deal with the possibilities of growing pyrethrum plants in the United States, the active principles, the evaluation of pyrethrum by chemical methods, the correlation of chemical assays and biological tests, the manufacture of pyrethrum insecticides, and the ways in which they are used.

RISTORCELLI (A.). **Sur les phlébotomes du Maroc.**—*Arch. Inst. Pasteur Maroc* **2** fasc. 2 pp. 367–382, 1 pl., 1 map, 7 figs., 18 refs. Casablanca, 1940. **Sur les phlébotomes du Maroc. Deuxième note.**—*T. c.* fasc. 3 pp. 521–533, 3 figs., 9 refs. 1941.

The first paper is concerned with a collection of *Phlebotomus* from southern Morocco already noticed [*R.A.E.*, B **28** 69] and includes descriptions of *P. longicuspis*, Nitzu., and the two new varieties [*loc. cit.*]. The second contains further records, descriptions of a new variety and the previously unknown male of another (both of the *minutus* group), and a list of the 11 species and varieties known to occur in Morocco.

MATHESON (R.). **Notes on** *Anopheles occidentalis* **D. & K. and** *Anopheles quadrimaculatus* **Say.**—*Mosq. News* **5** no. 1 pp. 1–3, 1 fig., 1 ref. New Brunswick, N.J., 1945.

Anopheles maculipennis var. *occidentalis*, D. & K., occurred in large numbers near Cayuta Lake, New York, in 1942 [*R.A.E.*, B **32** 131], while *A. quadrimaculatus*, Say, was much less plentiful, and the same was true in the early parts of the two following seasons. Adults of both species were scarce in the summer of 1943, but *A. quadrimaculatus* became the dominant species in the summer of 1944, and appeared in huge numbers, while *A. m. occidentalis* was very scarce from August onwards. The water level and vegetation of the lake changed from 1942 to 1944, but the altered conditions appeared to be as highly suitable for *A. m. occidentalis*, which failed to breed in any considerable numbers, as for *A. quadrimaculatus*. Attention is drawn to these observations because *A. quadrimaculatus*, a vector of malaria, could be considered very unimportant on the basis of those made in 1942 and 1943, whereas the opposite conclusion would have to be drawn from the evidence collected in 1944, and similar conditions may exist in many other places.

Attempts to establish a colony of *A. m. occidentalis* failed. Study of the chaetotaxy of 16 larvae with branched inner clypeal hairs, six of which were shown by rearing to be *A. m. occidentalis* and ten *A. quadrimaculatus*, showed that in *A. m. occidentalis* the inner clypeal hairs are spaced close together at their bases, and hair no. 2 of segment four of the abdomen is quite long, rather slender and has four or five branches arising near the middle, while in *A. m. quadrimaculatus* the clypeal hairs are spaced far apart at their bases, and hair no. 2 of the fourth abdominal segment is stout and usually unbranched, though occasionally it may be branched near the tip. Hundreds of adults reared from larvae with unbranched inner clypeal hairs were *A. quadrimaculatus*.

CHAMBERLIN (J. C.) & LAWSON (F. R.). **A mechanical Trap for the Sampling of aerial Insect Populations.**—*Mosq. News* **5** no. 1 pp. 4-7, 5 figs., 1 ref. New Brunswick, N.J., 1945.

A description is given of a mechanical trap in which nets with an opening 2 sq. ft. in area rotate in a horizontal plane describing a circle 12 ft. in diameter, so that each net will theoretically collect the insects from about 248,000 cu. ft. of air per hour if rotated at 55 rounds per minute (23–24 miles per hour). The power can be supplied by electricity or a petrol engine. The insects are held in a removable collecting bag with wire frame or copper-gauze bottom and are generally not seriously damaged if the bags are cleared fairly frequently. The net can also be attached to a car if it is desired to sample populations over an extended area. Travelling speeds up to 45 miles per hour have been used.

STAGE (H. H.) & CHAMBERLIN (J. C.). **Abundance and Flight Habits of certain Alaskan Mosquitoes, as determined by means of a Rotary-type Trap.**—*Mosq. News* **5** no. 1 pp. 8-16, 6 figs., 2 refs. New Brunswick, N.J., 1945.

Records are given of mosquitos caught in Alaska with Chamberlin & Lawson's rotary trap [see preceding abstract], which was operated almost nightly from late April to the middle of September 1944. Data are included on the relative abundance of the various species at different times during the season and under different conditions of light intensity, temperature and precipitation. The trap was several hundred feet from breeding grounds and was operated without bait. Very few mosquitos were taken during complete daylight or darkness. Catches were highest at nightfall when nearly 80 per hour were sometimes taken, and there was also a dawn flight, but it was considerably smaller than the evening one, almost certainly because of the lower temperature. Light rain during periods otherwise favourable did not inhibit flight. A trap on a car was also used on a few occasions. Mosquitos were caught in it in the morning, in the evening and at night, but not during the day, though several were taken biting in daylight. A complete list is given of the 28 species of mosquitos recorded from Alaska by various collectors, of which are least 11 were found in the present studies.

BICKLEY (W. E.). **The anal Gills of Mosquito Larvae.**—*Mosq. News* **5** no. 1 p. 18, 2 refs. New Brunswick, N.J., 1945.

The length of the anal gills (tracheal gills, anal papillae) is a useful and usually reliable character for distinguishing salt-water mosquito larvae from those of similar fresh-water species, particularly in the case of Anophelines. Larvae of *Anopheles atropos*, D. & K., and *A. crucians bradleyi*, King, which breed in salt water have gills much shorter than the anal segment, whilst those of *A. quadrimaculatus*, Say, *A. crucians georgianus*, King, *A. crucians crucians*, Wied., and *A. punctipennis*, Say, usually have gills as long as the anal segment

or longer. The gills are considered to be of little importance in respiration [*cf. R.A.E.*, B **34** 153], and Wigglesworth [**27** 169] stated that their chief function appears to be the taking up of chloride ions to maintain the normal salt concentration of the haemolymph.

Roy (D. N.). **Entomology (Medical and Veterinary).**—$9\frac{3}{4} \times 7\frac{1}{2}$ ins., xii+358 pp., 162 figs., many refs. Calcutta, Saraswaty Library, 1946. Price *Rs.* 30.

This text-book is arranged systematically and almost the whole of it is devoted to Arthropods that transmit diseases or are otherwise harmful to man and animals. The matter has been compiled from various sources and includes information on morphology, life-histories and habits. Considerably more than half the space is given to Diptera, and about a fifth of it to mosquitos of the genus *Anopheles*. Keys and tables for the identification of adult females and larvae of the Indian species of *Anopheles*, and notes on the distribution of these species and usually on their seasonal occurrence, habits and importance are included, together with a survey of the distribution of the principal malaria vectors of the world arranged geographically, and one of the principal vectors in India arranged by Provinces. Factors connected with the spread of malaria, methods of making a survey of malaria and its vectors and the control of both are discussed.

The method adopted for the more important of the remaining groups is usually to describe the morphological features of the group and to indicate its sub-divisions and the relations of its members to disease, with relevant notes on bionomics and sometimes brief indication of control measures. References to the literature are given at the end of nearly all sections. Notes on general laboratory technique are included.

Papers noticed by Title only.

[Yaguzhinskaya (L. V.).] **Ягужинская (Л. В.). The Morphology of the Blood Clot and the chemical Changes in the Blood Pigment at different Stages of Digestion in the Female of** *Anopheles maculipennis* **Mgn.** [*In Russian.*] —*Med. Parasitol.* **14** no. 2 pp. 38–45, 3 figs., 27 refs. Moscow, 1945.

Leví Castillo (R.). **A new Variety of the** *Anopheles pseudopunctipennis* **Complex in Ecuador (Diptera : Culicidae)** [description of the egg and adult characters of var. *levicastilloi*, Leví Castillo].—*Mosq. News* **5** no. 1 pp. 17–18, 2 figs., 8 refs. New Brunswick, N.J., 1945. [*Cf. R.A.E.*, B **33** 156; **34** 40.]

Stage (H. H.). **References to Literature of Interest to Mosquito Control Workers** [chiefly published in 1943 and 1944].—*Mosq. News* **5** no. 1 pp. 29–32. New Brunswick, N.J., 1945. [*Cf. R.A.E.*, B **34** 9.]

Langeron (M.). **Anophèles du Grand Atlas et de l'Anti-Atlas marocain.**—*Arch. Inst. Pasteur Maroc* **2** fasc. 2 pp. 357–359, 4 refs. Casablanca, 1940. [See *R.A.E.*, B **27** 78.]

Lewis (D. J.). **Observations on the Distribution and Taxonomy of Culicidae (Diptera) in the Sudan.**—*Trans. R. ent. Soc. Lond.* **95** pt. 1 pp. 1–24, 2 fldg. maps, 22 refs. London, 1945.

Christophers (Sir S. R.). **Structure of the** *Culex* **Egg and Egg-raft in relation to Function (Diptera).**—*Trans. R. ent. Soc. Lond.* **95** pt. 2 pp. 25–34, 4 pls., 2 refs. London, 1945.

METCALF (R. L.), HESS (A. D.), SMITH (G. E.), JEFFERY (G. M.) & LUDWIG (G. W.). **Observations on the Use of DDT for the Control of** *Anopheles quadrimaculatus*.—*Publ. Hlth Rep.* **60** no. 27 pp 753-774, 4 pls., 1 fig., 4 refs. Washington, D.C., 1945.

An account is given of studies carried out in the Tennessee Valley during 1943 and 1944 on the use of DDT as a spray to leave a toxic residue in buildings for the control of adults of *Anopheles quadrimaculatus*, Say, and a dust, spray or thermal aerosol applied from aeroplanes for the control of Anopheline larvae and adults out of doors. The aeroplane tests have already been noticed [*R.A.E.*, B **34** 98–99]; preliminary observations in connection with them afforded no evidence that DDT dusts or thermal aerosols injured fish or other aquatic organisms when applied by aeroplane at rates of 0·1 lb. DDT per acre, though solutions of 5 per cent. DDT in kerosene applied at about 0·25 lb. DDT per acre were quite destructive to aquatic insects living in close contact with the surface of the water, particularly Hemiptera and Coleoptera.

The following is substantially the authors' summary of the experiments with sprays used to leave a toxic residue, all of which were emulsions prepared from a concentrate consisting of DDT in xylene with Triton as emulsifier [*cf.* **34** 98]. Spray-chamber tests indicated that the median lethal doses of DDT for males and females of *A. quadrimaculatus* are about 7 and 12 mg. per 1,000 cu. ft., respectively, as compared with 1 and 1·5 mg. for pyrethrins. Laboratory observations of wall board sprayed at 40, 200 and 1,000 mg. DDT per sq. ft. showed that there was no significant difference in the initial toxicity of the various dosages to adults of *A. quadrimaculatus*, the percentage mortality being determined primarily by the period of contact. The duration of the toxicity of the deposit, however, depended on the rate of application, though it was not directly proportional to it. Complete kill of adults exposed for one hour was effected for from four to 12 weeks, according to the dosage. Wooden nail kegs [*cf.* **31** 52] treated with DDT at 20, 200 and 2,000 mg. per sq. ft. remained highly toxic for 18–22 weeks. The exposure time required for complete knock-down during the first 18 weeks varied from one to six hours according to the dosage and the age of the treated surface. Barns housing livestock and treated at about 200 mg. DDT per sq. ft. remained almost entirely free of flies and mosquitos for at least 11 weeks. In unoccupied experimental houses treated with DDT at about 250 mg. per sq. ft., the deposit remained toxic to adults of *A. quadrimaculatus* for at least 15 weeks. A deposit of 200 mg. per sq. ft. in occupied dwellings lost its toxicity more rapidly, but showed some effect for at least two months. The loss of toxicity by a treated surface appeared to be due chiefly to the flaking off of DDT crystals. Smooth enamelled or papered surfaces lost their toxicity more rapidly than rough wooden surfaces.

Observations in kegs, barns and houses indicated that a treated surface exerts a repellent action as an irritant after the mosquitos have been in contact with it for a short period. The use of the sprays did not keep adults of *A. quadrimaculatus* from entering houses but prevented biting for a week or two and gave partial protection for as long as eight or ten weeks. Of mosquitos escaping from a treated house, 95–100 per cent. had already received a lethal dose. The reaction of the adults to treated surfaces remained fairly constant for 15 weeks after treatment. Exposure to treated surfaces reversed the normal reactions of the mosquitos to light, making them positively phototropic.

BISHOPP (F. C.), LAAKE (E. W.) & WELLS (R. W.). **Cattle Grubs or Heel Flies with Suggestions for their Control.**—*Farmers' Bull. U.S. Dep. Agric.* no. 1596 (revd.), 22 pp., 18 figs. Washington, D.C., 1944.

This bulletin is a revision of one already noticed [*R.A.E.*, B **17** 209] and the information contained in it is the same except for the section on control, which includes data on the application of derris or cubé in dusts and washes [**33** 173;

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34 97, 173] and in sprays for large herds [**33** 173 ; **34** 97, 166]. Derris powder for the control of *Hypoderma lineatum*, Vill., and *H. bovis*, Deg., should contain at least 1 per cent. rotenone and should be ground so that 90 per cent. will pass through a 200-mesh sieve. Ground derris or cubé root mixed with one of the better diluents [**34** 97] so that the whole contains 1 per cent. rotenone and the accompanying resins is more effective than is undiluted cubé or derris that contains more rotenone.

COBBETT (N. G.) & SMITH (C. E.). **DDT has Possibilities of becoming a Remedy for Sheep Ticks.**—*J. Amer. vet. med. Ass.* **107** no. 822 pp. 147–148. Chicago, Ill., 1945.

In studies made in July and August 1944 of the possible effectiveness of DDT in dips for the control of the sheep ked, *Melophagus ovinus*, L., 408 moderately infested shorn ewes and rams and unshorn spring lambs were treated in Colorado in unheated suspensions containing 0·25, 0·5 or 1 per cent. DDT and 75 moderately infested unshorn lambs in New Mexico in suspensions containing 0·1, 0·25 or 0·5 per cent. The sheep were kept in the bath only long enough to ensure thorough wetting. Animals chosen at random from each lot in each flock were examined 24 hours and seven days after dipping. Further examinations were made weekly for 60 days in New Mexico and monthly for 90 days in Colorado. Many dead keds were found throughout the examinations. Only one living example, newly emerged and very inactive, was found at the first examination and none a week later. Newly emerged living keds were found on lambs of each lot in the New Mexico flock 14 days after dipping, but thereafter no living individuals were found in either flock. Dipping, even in 1 per cent. suspensions, caused no apparent injury to the animals. The DDT did not break down into particles of sufficient fineness to produce a uniform suspension in the water, and only the agitation of the dip by the swimming sheep prevented it from settling rapidly to the bottom. If large flocks of sheep were being dipped, the lack of uniformity in the suspension might result in most of the DDT being carried out by the animals early in the process of dipping, and the practicability of incorporating it in sheep dips will therefore depend largely on finding a suitable solvent or satisfactory suspending and dispersing agents for it. Neither methyl alcohol nor a commercial sulphonated soybean-oil emulsifier proved satisfactory for this purpose, and the latter caused an undesirable matting of the wool on dipped sheep.

WRIGHT (M.). **Dragonflies predaceous on the Stablefly** *Stomoxys calcitrans* **(L.).**—*Florida Ent.* **28** no. 1 pp. 11–13. Gainesville, Fla., 1945.

Large swarms of dragonflies were observed at irregular intervals in the late summer and autumn of 1941 along beaches in western Florida where they were reported by Dove & Simmons to prey on *Stomoxys calcitrans*, L. [*R.A.E.*, B **31** 95]. They were again seen consuming large numbers of the fly in 1942 and 1943. The presence of adults of *S. calcitrans* along the beaches in appreciable numbers always follows a northerly (off-shore) breeze, as it blows them from the wooded interior, where they shelter after being dispersed from their breeding areas along the beach by south winds. Daily observations during the 1943 season showed that their appearance or disappearance was always followed some hours later by the corresponding movement of the dragonflies. It is concluded that the appearance of swarms of dragonflies along the beaches is due to a definite migration to a point of high concentration of food and not to the wind, as they do not appear when there are northerly winds before or after *Stomoxys* is abundant ; the species concerned are strong fliers and no similar swarms have been observed inland.

ACREE jr. (F.), JACOBSON (M.) & HALLER (H. L.). **An Amide possessing insecticidal Properties from the Roots of** *Erigeron affinis* **DC.**—*J. organic Chem.* **10** no. 3 pp. 236–242, 1 graph, 5 refs. Baltimore, Md., 1945.

Erigeron affinis is a composite that grows near Mexico City, where the roots are used in the preparation of native insecticides. The petroleum-ether extractive from the powdered roots has been found to be toxic to various insects including adult mosquitos, and to have the same order of paralysing action and toxicity to house-flies [*Musca domestica*, L.] as the pyrethrins. The toxic fraction was isolated from the extractive by a method already described [*R.A.E.*, B **33** 98] and proved to be an unsaturated isobutylamide, for which the name affinin is proposed. Its formula is discussed.

HALL (S. A.), ADAMS jr. (R. K.) & HALLER (H. L.). **Photochemical Dimerization of *n*-Butyl Mesityl Oxide Oxalate.**—*J. Amer. chem. Soc.* **67** p. 1224. Easton, Pa., 1945.

It was found that exposure to ultraviolet light of a thin film of Indalone [*cf. R.A.E.*, B **33** 107, etc.], which consists of two forms of n-butyl mesityl oxide oxalate, caused irreversible and quantitative polymerisation of the liquid ester to a crystalline dimer. Dimerisation was complete after exposure of a thin film to March sunlight for 3½ hours or to an ultraviolet lamp for one hour, and is of importance because of the consequent loss of repellency to insects.

HALLER (H. L.) & others. **The chemical Composition of technical DDT.**—*J. Amer. chem. Soc.* **67** pp. 1591–1602, 21 refs. Easton, Pa., 1945.

CRISTOL (S. J.), HAYES (R. A.) & HALLER (H. L.). **Determination of 1-trichloro-2, 2-bis (*p*-chlorophenyl) ethane in technical DDT.**—*Industr. Engng Chem.* Anal. Edn. **17** no. 8 pp. 470–472, 1 graph, 7 refs. Easton, Pa., 1945.

In the first of these papers, the authors point out the importance of studying the composition of technical (commercial-grade) DDT in order to determine the nature and amount of the by-product materials and to compare them insecticidally and pharmacologically with 1-trichlor-2,2-bis(parachlorphenyl)ethane, referred to as p,p′-DDT. The technical product was found to be a complex mixture containing more than 70 per cent. p,p′-DDT, with 1-trichlor-2-o-chlorphenyl-2-p-chlorphenylethane (o,p′-DDT) as the major impurity. In all, 14 compounds were isolated from various samples of technical DDT; all of these and the uncrystallisable oils were tested as insecticides, but although some were effective, none was so toxic as p,p′-DDT.

In the second paper, a method is described for the determination of p,p′-DDT in technical grades of DDT, with modifications for use in the case of dusts and by-product oils.

BARTHEL (W. F.) & HALLER (H. L.). **Apparatus for rapid Removal of Solvents.**—*Industr. Engng Chem.* Anal. Edn. **17** p. 529, 1 fig., 2 refs. Easton, Pa., 1945.

When purified pyrethrum concentrates are prepared with nitromethane as a solvent, it is difficult to prevent the decomposition of the pyrethrum concentrate while distilling the nitromethane [*cf. R.A.E.*, B **33** 98]. The authors therefore constructed an apparatus, which is described and figured in this paper, with which the solvent is removed under reduced pressure. It also proved effective for removing medium-boiling solvents from other plant extracts and organic compounds and for the rapid concentration of solutions. For liquids boiling below 70–80°C. it can be used without vacuum.

Toop (C. R.) **Sarcoptic Mange of Pigs.**—*J. Dep. Agric. W. Aust.* (2) **22** no. 1 pp. 65–70, 3 figs. Perth, W.A., 1945.

Mange of pigs caused by *Sarcoptes suis*, Gerl., is well established in Western Australia. Infestation is transmitted by direct contact and also by contact with infested premises, since the mites can survive in bedding and litter for four weeks under cool, moist conditions, though for only a few days when it is hot and dry. Notes are given on the effects of infestation and on the life-history of the mites [*cf. R.A.E.*, B **29** 182], in which it is stated that the egg stage lasts 3–10 days and the complete life-cycle 2–3 weeks. The whole surface of the body may become involved in six weeks. Pigs of all ages and breeds are susceptible and lose condition through infestation, but it is most serious and sometimes fatal in young ones.

Excellent control can be obtained with crude oil or used lubricating oil applied by dipping, spraying or hand-dressing. Dipping is the most practical and effective method, particularly for large herds, and a concrete bath that has been found satisfactory is described. It is filled with water covered with a 6-inch layer of oil, which should be renewed periodically at the rate of 1½ pints per animal. Heads should be submerged once during dipping, and the treated pigs should be protected from bright sunlight and allowed to rest for 24 hours. To effect eradication, a whole herd must be treated. Sows within two weeks of farrowing should not be dipped, but it is safe to dip them and their litters when the young pigs are four weeks old. A single treatment is effective in the early stages of infestation, but two or more at intervals of ten days are necessary in more advanced cases. Lime-sulphur dips are also effective if used four times at intervals of seven days.

Jenkins (C. F. H.) **Entomological Problems of the Ord River Irrigation Area.**—*J. Dep. Agric. W. Aust.* (2) **22** no. 2 pp. 131–145, 4 figs. Perth, W.A., 1945.

This is a preliminary report on the injurious Arthropods that occur in the Kimberley region in the north of Western Australia, based mainly on information obtained during a visit to the Ord River Valley between 17th April and 15th July 1944, and includes sections on pests of livestock and mosquito vectors of malaria and dengue. Both these diseases are endemic in the Kimberley region, where the Anophelines found are *Anopheles annulipes*, Wlk., and *A. amictus*, Edw. The latest outbreak of malaria in Western Australia took place in 1929–34 and progressed from the Northern Territory to the Ord and Fitzroy Valleys. *Aëdes aegypti*, L., is widespread in Western Australia, but dengue, of which it is the vector, persists only in the tropical parts. This disease was very common at Broome before measures for the control of *A. aegypti* were instituted by the army.

The important stock pests are *Siphona* (*Lyperosia*) *exigua*, de Meij., and *Boophilus annulatus microplus*, Can. *S. exigua*, which attacks buffaloes and cattle and to a smaller extent horses, mules and donkeys, is thought to have entered Western Australia about 1910 and has spread south through most of the Kimberleys to 20° south latitude. It thrives best under warm, moist conditions and is most active in the coastal areas and during and just after the wet season. Its spread southwards has been checked by the dry belt, a cattle-free quarantine zone and the treatment of all cattle shipped from north-western ports [*cf. R.A.E.*, B **18** 117; **20** 85, 178]. *B. a. microplus* is widely distributed from Wollal (20° south latitude) northwards on cattle and, to some extent, horses. The history of its progress in Western Australia since it was first reported in 1896 is briefly reviewed. It is prevented from spreading farther south by the dry belt and compulsory dipping of cattle moving southwards from infested areas. In these, most cattle become immune from

tick fever [piroplasmosis] when they are calves, but isolated areas have remained free from ticks despite efforts to establish them, and mortality is heavy among cattle moving out through infested country. *Lucilia cuprina*, Wied., is not known to occur in the Ord River Valley, and the greatest precautions should be taken to prevent its introduction. Severe infestation of sheep by blowflies, presumably of this species, occurred at three stations in the south-western portion of the Kimberleys in 1942. In the Carlton Reach area, *Chrysomyia* (*Microcalliphora*) *varipes*, Macq., *C. rufifacies*, Macq., *C. micropogon*, Bigot, and another species of *Chrysomyia* were collected as adults on carcases of kangaroos.

LEVER (R. J. A. W.). **Entomological Notes.**—*Agric. J. Fiji* **16** no. 2 pp. 46–49, 17 refs. Suva, 1945.

A check list is given of the mosquitos of Fiji with notes on some of the species, and the local distribution of *Aëdes horrescens*, Edw., is reviewed.

COVELL (G.). **Notes on the Distribution, Breeding Places, Adult Habits and Relation to Malaria of the Anopheline Mosquitoes of India and the Far East.** — *J. Malar. Inst. India* **5** no. 4 pp. 399–434, 1 fldg. map, 7½ pp. refs. Calcutta, 1944.

The author summarises information on the distribution, breeding places, adult habits and importance in relation to malaria of the 41 species and varieties of *Anopheles* that have been found naturally infected with malaria parasites or have been suspected of being vectors of the disease on epidemiological grounds in the area dealt with. This comprises India, Burma, Siam, Indo-China, southern China, Formosa, the Andaman and Nicobar Islands, Malaya, the East Indian Archipelago (including New Guinea and the Philippines), the Admiralty Islands, New Britain, New Ireland, the Solomons, New Hebrides and northern Australia. The paper is based on parts of earlier memoirs by the author [*R.A.E.*, B **16** 41 ; **19** 163], but much additional information is included, a great deal of which was obtained by consulting the works of Kumm [**18** 225], Taylor [**32** 95], and Russell, Rozeboom & Stone [**32** 102]. The study involved revealed the need for much further research on the daytime resting places, time of biting, preferential feeding habits and effective flight-range of the various species, and on the existence of biological races.

IYENGAR (M. O. T.). **Problems relating to Malaria Control in deltaic Bengal.**— *J. Malar. Inst. India* **5** no. 4 pp. 435–447, 6 refs. Calcutta, 1944.

Anopheles philippinensis, Ludl., is the only Anopheline that has consistently been found infected with malaria parasites in the deltaic region of Bengal [*cf. R.A.E.*, B **31** 238, etc.]. The results of the dissection of 9,705 females of 12 species from ten areas in the region in the course of investigations by the author are given in an appendix. Infection was found in 64 out of 865 females of *A. philippinensis* and in one out of 742 of *A. ramsayi*, Covell. *A. philippinensis* has shown high rates of infection even under conditions of static malaria, and its prevalence is positively correlated with local malaria endemicity. These facts indicate that it is the chief vector in the deltaic region (excluding the estuarine zone [**29** 7]). General and gland infection rates in it are high from July to December (wet season) and low from January to June. Oöcysts found in the dry season show signs of suppressed development or deterioration. As it is most prevalent and the natural infection rates and frequency of sporozoite infection are highest from September to November, this is probably the period when most transmission of malaria occurs.

During the day, *A. philippinensis* rests mainly in houses (generally in bedrooms and kitchens) and only very rarely in cattle sheds. Unlike most Anophelines, it usually rests within 1–1½ ft. of the floor. Its main breeding season is from July to October. Larvae are usually found in large, uncontaminated, permanent, sunlit ponds and less frequently in sluggish water-courses and overgrown marshes, but not ordinarily in small temporary collections of water or in rice-fields. They are most plentiful in water containing vegetation of the type that forms dense sub-aquatic bushes. These often reach the surface of the water and offer good shelter without obstructing the sunlight. The plant with which the larvae are most frequently associated is *Hydrilla verticillata*. Plants such as *Eichhornia speciosa* that grow over the water surface and shade it prevent breeding, apparently by inhibiting the growth of the non-filamentous green algae that form the main food of the larvae. As part of a scheme for the control of malaria at Jessore, open parts of the river have been stocked with *Eichhornia* and a stretch of three miles is now covered with it and free from *A. philippinensis*. Sudden intensive breeding of the latter in a large pond in the centre of one village was followed by an outbreak of malaria in 1941, but its larvae were no longer found and no epidemic of malaria occurred in 1942 or 1943, after the pond was stocked with *Eichhornia*. Certain algae, such as *Microcystis aeruginosa*, *Anabaena*, *Oscillaria* and *Euglena* are also unfavourable for the breeding of this Anopheline.

The recommended measures for the control of *A. philippinensis* in the deltaic region are spraying dwelling rooms from June to December, removing all aquatic vegetation from ponds or establishing a dense growth of *Eichhornia* to cover the water surface, and raising the water table through irrigation or otherwise [*cf.* **31** 238]. Clearing of aquatic vegetation alone has been found to control the transmission of malaria effectively. Cost can be reduced by dealing only with those ponds in which *A. philippinensis* is breeding, and there are usually only a few of these, but under this system, all potential breeding places must be examined each week.

Viswanathan (D. K.), Ramachandra Rao (T.) & Rama Rao (T. S.). **The Behaviour of *Anopheles fluviatilis*. Part II. Nocturnal Movements and daytime Resting Places and their Bearing on Spray-killing.**—*J. Malar. Inst. India* **5** no. 4 pp. 449–466, 8 refs. Calcutta, 1944.

The following is based on the authors' introduction and summary. In preliminary observations on the behaviour of *Anopheles fluviatilis*, James, in North Kanara District, Bombay Presidency, the number of adults taken in houses by day was high in relation to the intensity of breeding, which suggested that the species did not rest out of doors in the day to any great extent [*cf. R.A.E.*, B **33** 48]. During 1943, however, catches remained appreciable after houses had been sprayed twice a week for several weeks with pyrethrum extract, and the incidence of malaria continued to increase although infection rates among the females caught were significantly lower than usual. It was therefore surmised that there was considerable nocturnal movement involving a change of daytime resting place and probably escape from the spray. The possibility that the females rested in outdoor shelters had also to be considered [*cf.* **23** 17; **30** 103; **33** 135], and further studies of their nocturnal activity and daytime resting places were accordingly made in 1943 and 1944.

From September to November, when the gonotrophic cycle takes 48 hours in the laboratory, females from houses were in the proportion of 10 of Class B (freshly fed) to 3·5 of Classes C (containing half digested blood and half developed ova) and D (containing almost fully digested blood and nearly fully developed ova) together. From December to February, when the cycle takes 72 hours in the laboratory, there were 10 females of Class B to 5·4 of Class C and 4·1 of Class D. It is therefore concluded that about 60 per cent. of the females leave

indoor for outdoor shelters each night in the former period and about 40 per cent. in the latter. In March 1944, one male of *A. fluviatilis* and 16 females that had all taken blood-meals were collected by day from deep clefts in rocky banks or the undersurface of the banks shaded by undergrowth. It was inferred from experiments with marked females that most of those in Class C leave their daytime resting places at dusk or soon after it. As no female of this class was recovered from an indoor shelter on the morning following release but some were recovered on subsequent nights and mornings when they had entered tents or houses to feed, it is concluded that they must have resorted to outdoor shelters on the night of their release. Similar experiments with Class B females showed that most of these leave the places where they have fed for outdoor shelters between the time of feeding and dawn. About 71 per cent. of females of *A. fluviatilis* were found to enter houses to feed at dusk or during the first quarter of the period of darkness, 19 per cent. in the second quarter, 7 per cent. in the third quarter and 3 per cent. in the last quarter [*cf.* **33** 48].

These findings are discussed with reference to their bearing on the usefulness of spraying in houses for the control of the adults as an anti-malaria measure and the frequency with which this should be carried out. Daily spraying is advocated in sparsely populated areas where control of the larvae may be impracticable, as otherwise the number of females escaping through movement at night would be dangerous in view of the high infection rate of *A. fluviatilis*. In larger villages, the recommended procedure is the use of measures against the larvae combined with spraying twice a week when the gonotrophic cycle takes 72 hours and on two consecutive days with intervals of two days when it takes 48 hours [*cf.* **33** 136]. Spraying is restricted to the period of transmission in the area concerned.

RAO (G. R.). **Malaria in the Jharia Mining Settlement, Bihar. Parts II, III and IV.** (Abstract.)—*J. Malar. Inst. India* **5** no. 4 p. 471, 1 ref. Calcutta, 1944.

The first part of this paper contained a record of observations on malaria and Anophelines in the Jharia Mining Settlement, Bihar, in 1938–40 [*R.A.E.*, B **30** 173]. The three subsequent parts deal with investigations carried out up to 1943. As a result of over 13,000 dissections, it was shown that *Anopheles fluviatilis*, James, is the principal vector of malaria and *A. stephensi*, List., a secondary one, while *A. annularis*, Wulp, appears to be the only vector in the south-eastern corner of the settlement, where the physical features resemble those of deltaic Bengal. *A. pallidus*, Theo., and *A. culicifacies*, Giles, seem to be relatively unimportant, though chance infections occur in both. Adults of *A. fluviatilis* were found almost exclusively in dwellings, *A. stephensi* and *A. pallidus* in about equal numbers in dwellings and cattle sheds and *A. annularis* and *A. culicifacies* principally in cattle sheds.

Malaria epidemics occur during the monsoon (July to October), but the control measures adopted are claimed to have reduced considerably the malaria rate in those collieries where they have been carried out. The output of larvae of the five species of *Anopheles* in which natural infections have been found is lowest at the height of the malaria season. This is held to indicate that measures against the adults are most likely to be effective at this time, while particular attention should be given to measures against the larvae before the peak period of transmission, and if necessary after it.

BATES (M.). **Observations on Climate and seasonal Distribution of Mosquitoes in eastern Colombia.**—*J. Anim. Ecol.* **14** no. 1 pp. 17–25, 1 pl., 3 figs., 13 refs. London, 1945.

In mosquito collections made at Villavicencio, Colombia, in 1941–44, in connection with studies on the epidemiology of jungle yellow fever there

[*R.A.E.*, B **32** 183, 184], the abundance of diurnal species was estimated in three forest areas from the numbers coming to bite man and that of nocturnal species in one of them by the use of a stable trap of the Egyptian type [**33** 97] baited with a donkey. Data are given on the monthly abundance of the nine commonest species of diurnal mosquitos taken in 1942 and 1943, which included *Haemagogus capricorni*, Lutz, and *Anopheles boliviensis*, Theo., in both years, and of the species taken in the same years in the trap. There were five of these, including *A. rangeli*, Gabaldon, Cova-García & López, in addition to unidentified species of *Culex*. Data on rainfall, relative humidity at noon and temperature are given for 1941, 1942 and 1943 and on evaporation for the two later years. The climate is very uniform, particularly as regards temperature, but there is a well marked, though not severe, warm, dry season from January to March and a cold, wet season from May to July. Evaporation largely counteracts the effect of precipitation in the dry season. Annual rainfall is between 150 and 200 ins.

H. capricorni, which is presumed to be the chief vector of jungle yellow fever around Villavicencio [**32** 184], was common in all types of forest in the area. The eggs, which are laid in tree holes and other collections of water in trees can resist prolonged desiccation, thus minimising the reduction in population due to periods of drought. The mean duration of the larval stage in one experiment in the laboratory was 11·1 days at 30°C. [86°F.], with some larvae completing development in seven days. It is considered likely that development in nature requires 2–3 weeks and that a generation occupies at least a month. Adults have been kept alive in the laboratory for more than 30 days at 25–27°C. [77–80·6°F.]. In the three forests studied, the adult population in 1942 and 1943 remained low during January, February and March, increased rapidly in April and May to reach a peak in June, and then declined to a moderate level, which was maintained from September to December. Abundance in the dry season was apparently related to the water available in the breeding places, and the increase in the rainy season could be attributed to the hatching of eggs placed relatively high in them. It appeared unlikely that a series of cycles of yellow fever virus could be maintained in *H. capricorni* throughout the year in one forest where there was a variation of 1:194 in density, but quite possible that it should be maintained in another where the variation was only 1:16. The two areas are only about $1\frac{1}{4}$ miles apart, the former on a hill and the latter in a ravine.

A. rangeli was about ten times as abundant in the 1942 catches as in those of 1943. The partial data for 1941 and 1944 indicated intermediate populations. The trend of the curves during the two years was very similar, with a peak in May and June when the adults were ten times as plentiful as in the dry season. As Anophelines like *A. rangeli* have no known mechanism for passing an unfavourable season [but *cf.* **30** 187], variations in the adult population presumably represent actual fluctuations in the total population. The number and size of the sunny ponds and roadside ditches in which *A. rangeli* breeds increase with the onset of the rains in April, but vary little from May to December. The decrease in population at this time presumably reflects some change in biological relationships.

Notes are given on the catches and breeding places of many of the other species taken, and the paper concludes with a discussion of the bearing of possible periods of suspended development at some stage of growth on fluctuations in population.

JACKSON (C. H. N.). **The Analysis of a Tsetse-fly Population. II.**—*Ann. Eugen.* **12** pt. 3 pp. 176–205, 6 figs., 13 refs. Cambridge, 1944.

This paper is a continuation of an earlier one [*R.A.E.*, B **29** 123] and contains the analysis of data obtained both earlier and later by marking adults of

Glossina morsitans, Westw., between 1935 and 1940 at Kakoma in Tanganyika Territory. Marking was first done by parties moving at random in a rectangle with an area of 1·8 sq. miles and later in the sub-divisions of a square with an area of 16 sq. miles enclosing the former rectangle [*loc. cit.*] and in a similar square at Kisoko eight miles away [**29** 124]. The author doubts the validity of his data published earlier on evaporation [**25** 163] and withdraws his statement against Nash's "optimum zone" [*cf.* **25** 163; **27** 19]. The mean monthly maximum and minimum temperatures and saturation deficit and total monthly rainfall for the period of the investigations and also the mean weekly saturation deficit are given. During the period, the climate underwent changes that may be part of a regular long-term cycle, believed to affect tsetse populations. These populations apparently tend to be lower in cooler years.

The data on dispersal generally confirm the earlier interpretation that because of re-immigration, there is little effective emigration from a 4×4 mile square after the first week [**29** 123]. The re-immigrants do not balance the emigrants, but effectively they nearly do so, because some of the emigrants leave in search of food and die without finding it. The male death-rate is shown to be correlated with saturation deficit and with the percentage of females in the catch of old flies [**33** 54], and, as old females appear only when hungry and hunger is associated with high saturation deficit, it is believed that failure to find food may be responsible for high mortality, though it is not suggested that this is the only or the commonest cause of death. The ratio of young to total males and the rate of emergence follow the death-rate rather closely. Both death-rate and emergence-rate almost invariably rise in the dry season, the emergence-rate partly because the pupal period is shortened. The changes in population observed at Kakoma cannot for various reasons be regarded as a reliable indication of the normal seasonal changes in *G. morsitans* elsewhere, but a remarkable fall from 1935 to early 1936 was not caused by the experimental conditions, for it affected a wide area. Evidence is given to show that activity is of minor importance in its effect on the fly-ground catch, which is associated mainly with real changes in population. The longest time for which any fly was found to live was 27½ weeks, which was recorded for a female captured and recaptured in 1938. Data are given on 13 flies, including three females, that were proved to have lived for more than ten weeks. All except one lived in the rainy season.

JACKSON (C. H. N.). **Comparative Studies of the Habitat Requirements of Tsetse Fly Species.**—*J. Anim. Ecol.* **14** no. 1 pp. 46–51, 6 refs. London, 1945.

In an attempt to obtain information on the reason for the climatic and vegetational preference of the various species, pupae of *Glossina morsitans*, Westw., which frequents miombo (*Isoberlinia-Brachystegia* broad-leaved deciduous woodland) in East Africa, and of *G. palpalis*, R.-D., a waterside species, were obtained from the Central Province of Tanganyika and from Uganda, respectively, and adults were allowed to emerge from them in a block of country near Shinyanga, Tanganyika, infested with *G. swynnertoni*, Aust., and *G. pallidipes*, Aust. The typical habitat of *G. swynnertoni* is thornbush dominated by *Acacia* and *Commiphora*. Some 300 adults of each sex of *G. morsitans* emerged in the thicketed south of the block in October 1943 (end of the dry season), in an area where *G. swynnertoni* was concentrated, and about 1,232 of each sex in the south and 422 in the north in early May 1944 (beginning of the dry season). About 287 of each sex of *G. palpalis* emerged in the south in early May near a pool in a habitat of *G. pallidipes* and about 350 of each sex in open thornbush in the north in late May and early June.

The mean weight of captured males of *G. morsitans* was not greatly different from that of males of *G. swynnertoni* after allowance had been made for the difference in size, but both were considerably lighter than *G. morsitans* in its own environment in which the proportionate water and fat contents were also higher. Minor differences in proportions of water, fat and residue between flies from the north and south of the area, habitats normally favouring *G. swynnertoni* and *G. pallidipes*, respectively, are discussed. Males of *G. palpalis* recovered in the south were rather light in weight but had a high proportion of fat and water. The criterion of size used in correcting for differences between *G. morsitans* and *G. swynnertoni* was the length of the middle part of the fourth longitudinal vein of the wing [*cf. R.A.E.*, B **34** 50]. The correlation between vein length and weight was very poor in *G. palpalis*. Teneral adults of the four species seemed to lose weight in the laboratory almost regardless of their initial weight. *G. palpalis* lost more water and more total weight than *G. swynnertoni* or *G. morsitans* under the same conditions. *G. swynnertoni* lost slightly more weight than *G. morsitans* in spite of its smaller size and presumed adaptation to a supposedly severer environment. Within the *morsitans* group, smaller individuals as well as smaller species lost practically the same amount of weight as larger ones, thereby losing more proportionately, so that, other things being equal, small flies are at a disadvantage in the field [*loc. cit.*]. It is thought possible that *G. swynnertoni* counteracts this disadvantage by being adapted to taking more frequent meals, which it is able to do because it is accustomed to live among a dense population of ungulate animals.

A considerable second generation of *G. morsitans* developed in the south, but practically no second generation appeared in the north where *G. swynnertoni* was plentiful, presumably because of hybridisation [*cf.* **34** 36, 51]. There was an indication that the second-generation flies were smaller than they would be in their natural environment. No evidence of a second generation of *G. palpalis* was observed in the field, though the pool near which the release was made did not dry up until it was due and recaptured first-generation females produced offspring in the laboratory.

VANDERPLANK (F. L.). **A hybrid Hermaphrodite of** *Glossina* **(Diptera).**—*Proc. R. ent. Soc. Lond.* (A) **20** pt. 10–12 pp. 105–106, 1 fig., 3 refs. London, 1945.

JACKSON (C. H. N.). **Pairing of** *Glossina morsitans* **Westwood with** *G. swynnertoni* **Austen (Diptera).**—*T.c.* p. 106, 1 ref.

The first paper contains a description of a hermaphrodite hybrid obtained by crossing a male of *Glossina swynnertoni*, Aust., with a female of *G. morsitans*, Westw. In the second are recorded observations carried out in view of Vanderplank's work [*R.A.E.*, B **34** 36], on field pairing by adults of the two species that had emerged from large numbers of pupae exposed for about ten days in an area [in Tanganyika] in which *G. swynnertoni* was abundant. Examination of copulating pairs taken within 100 yards of the point of release showed that all the females were unfed and had unhardened chitin. It was assumed that all young females of *G. swynnertoni* taken were from the experimental pupae. By periodically counting flies resting on the containers after emergence, it was estimated that *G. morsitans* and *G. swynnertoni* were emerging in the proportion of 5·24:1. The proportion of males of *G. swynnertoni* observed pairing with *G. morsitans* to those pairing with their own species was 4·9:1, and the proportion of males of *G. morsitans* pairing with their own species to those pairing with *G. swynnertoni* was 5·86:1. As both ratios were extremely close to expectation, it is concluded that the males of *G. swynnertoni* pair at random with either species and that the males of *G. morsitans* probably do so, though the number of the latter observed (48) was too small for a conclusive demonstration.

JACKSON (C. H. N.). **An artificially isolated Generation of Tsetse Flies (Diptera).**—*Bull. ent. Res.* **37** pt. 2 pp. 291–299, 2 figs., 7 refs. London, 1946.

Several thousand pupae of *Glossina morsitans*, Westw., were collected in the Central Province of Tanganyika, and adults were allowed to emerge from them for three days in July 1945 in country inhabited by *G. swynnertoni*, Aust., and *G. pallidipes*, Aust., at Shinyanga, but at a site where only very occasional individuals of these flies were likely to be encountered. In an analysis of the results of recaptures, flies are presumed to have emerged on the second day of release. The sex of the adults recovered in catches made every week-day except one for 63 days following emergence is shown in a table, together with data on dispersal, the weight of the males and their age as indicated by the degree of fraying of the hind margin of the wings [*cf. R.A.E.*, B **34** 50]. Six categories of wing fray were recognised and are figured. The mean age of the samples of males could be accurately deduced from the wear on the hind margin, but the age of individuals could not be told with any confidence by this method. The females did not wear out their wings so rapidly as the males. The method has given broadly reasonable results with numerous samples of *G. morsitans* and *G. swynnertoni* in their natural environment, but *G. palpalis* does not fray in the same manner. Moreover, it is not known to what extent the activity of the flies and consequently the fraying of their wings may vary with their age and with temperature.

Most teneral flies were caught within four days of emergence, but occasional ones were found up to the tenth day. These may have had a partial meal. Non-teneral flies first appeared in considerable numbers when a week old. The first was taken on the fourth day. The numbers of males did not fall off for four weeks, although some were presumably dying from various causes. It is possible that those up to two or three weeks old are somewhat inactive or that they delay to move away from the place of release. Males of *G. morsitans*, and of *G. swynnertoni* also, are inactive between the first and second meals. The females of *G. morsitans*, on the other hand, are much more active in the first three weeks of life than later. No male was taken after the ninth week.

The teneral males contained about 12 mg. water, which was increased after several meals to a maximum of about 18 mg. on the 17th day. They started with about 1½ mg. fat, which declined to 1 mg. before the first meal and then rose to about 3 mg. by the 17th day, after which there was no further increase. It is pointed out, however, that the flies in their natural environment are known to have a higher fat content [*cf.* **34** 198]. Residual weight behaved like the water, except that it was relatively very low in teneral flies and in the hungry flies that reappeared after the first meal. In this experiment, there was no evidence that smaller flies were at a disadvantage [*cf.* **34** 198, etc.].

Males dispersed, in any one direction, to a mean distance of 365 yards in one week, 484 yards in two weeks, 772 in three and 941 in four. The mean dispersal distance in the nine weeks' observations was 808 yards. This should be increased to allow for flies moving outside the recovery area. In spite of evidence of some pairing with *G. swynnertoni*, a considerable second generation appeared. It was concluded from dissection of females by W. H. Potts and calculations based on data on the duration of the developmental period at various temperatures given by Jack in a paper already noticed [**28** 22] that the females and pupae in nature lived at temperatures near those obtained in a screen at a standard meteorological station and not in specially cool ecoclimates.

RIBBANDS (C. R.). **Repellency of Pyrethrum and Lethane Sprays to Mosquitos.**—*Bull. ent. Res.* **37** pt. 2 pp. 163-172, 5 refs. London, 1946.

An account is given of experiments made in Assam from July to October 1945 (monsoon season) to study the repellent effect on species of the *Myzomyia*

group of *Anopheles* of spraying huts with pyrethrum extract or Lethane 384 (50 per cent. n-butyl carbitol thiocyanate in refined kerosene). The huts mostly had mud walls and a thatched roof and were windowless and open at the eaves. About 75 per cent. of the Anophelines were *A. minimus*, Theo., the rest being mainly *A. varuna*, Iyen., and *A. fluviatilis*, James. The term *A. minimus* is used throughout the paper to refer to this mixed population. Spraying in the afternoon with 0·1 per cent. pyrethrins in kerosene, at 25 cc. per 1,000 cu. ft. (0·05 cc. pyrethrins per hut), deterred 90 and 60 per cent. of *A. minimus* from entering on the first and second nights (as estimated from the numbers of fed females resting in the huts on the following days), and the repellent effect persisted to some extent for at least four days. A rather larger quantity of pyrethrins (0·075 cc. per hut.) applied as an aerosol produced by Freon-12 (dichlordifluoromethane) containing 0·4 per cent. pyrethrins and 8 per cent sesame oil had a similar but less marked effect, while 10 per cent. Lethane 384 in kerosene at 25 cc. per hut was much less repellent on the first night and had no discernible effect on the second. These results indicate that the repellency is due to the pyrethrum in the first two instances and the quickly evaporating Lethane in the third and in no case to the kerosene. Different species varied greatly in their sensitiveness to the repellents. *A. vagus*, Dön., was not so sensitive as *A. minimus* to pyrethrum but was slightly more so than mosquitos of other genera. In experiments in which some huts were sprayed with pyrethrum extract in kerosene in the afternoon as usual and again (to collect the mosquitos) at 11 p.m. while other huts were sprayed at 11 p.m. only, the afternoon spray caused a reduction in the night population of females of *A. minimus* (other than half-gravid females) similar to that previously found in the resting day populations, and two-thirds of the females in the 11 p.m. catches were unfed. It is inferred that the repellency of pyrethrum results in reduced entry caused by vapour effect and not in abnormal egress induced by irritation.

Two types of repellent effect were indicated. True repellency was the more important, and males were more sensitive to it than females of the same species. The repellency of pyrethrum was of this kind, and also a short-lived repellency shown by Lethane to *A. vagus*. There was also an effect, influencing females of anthropophilic species, that resulted from the obscuring of attractive human scents by the chemical odours [*cf. R.A.E.*, B **34** 158]. Lethane had repellency of this kind for *A. minimus*. These results show that the risk of transmission of malaria by *A. minimus* can be considerably reduced by thorough spraying of living quarters every evening. They also show the superiority of Lethane over pyrethrum for use in any experiments that involve repeated catchings.

BARNES (S.). **The Use of Adhesive Agents in DDT Sprays.**—*Bull. ent. Res.* **37** pt. 2 pp. 173–176, 3 refs. London, 1946.

As previous tests had shown that the toxicity to *Cimex lectularius*, L., of a smooth surface treated with DDT diminished considerably after repeated rubbing or washing [*R.A.E.*, B **34** 26], work was undertaken to determine whether the addition of coumarone resin, boiled linseed oil or a mixture of equal parts of paraffin wax (melting point 52°C.) and commercial vaseline would improve the ability of DDT to withstand such operations. The extent to which the addition of these adhesives would improve the duration of toxicity and reduce absorption of DDT by a porous surface (cement) was also investigated. Adults of *C. lectularius* were used as the test insects, and the DDT was the pure para para compound. In the tests of durability and absorption, it was applied as a 4 per cent. solution with 4 per cent. adhesive in a mixture of light oil (odourless distillate) and ethylene dichloride (9 :1)

to cement and to wood painted three years earlier. Tests were made after 48 hours and one, two and three months, and the surfaces were exposed to diffuse daylight between trials. At 0·005 and 0·01 mg. DDT per sq. cm., painted wood was more toxic after 48 hours when coumarone resin was used than with either of the other adhesives. Toxicity was uniformly high with all adhesives when the deposits were 0·03 and 0·06 mg. per sq. cm. (89–100 per cent. at the latter dosage *cf. loc. cit.*). The toxicity of painted wood had decreased considerably one month after treatment with the lower dosages and lasted for three months only when the highest dosage was applied. The toxicity of cement was about the same at a given time after the application of a certain dosage, irrespective of which of the three adhesives had been used, and decreased gradually over the three months.

The removal of a deposit of DDT (0·03 mg. per sq. cm.) from painted wood and glass by repeated dusting or washing with tepid water and soap was not prevented by the presence of an equal quantity of the adhesive or, in a test with linseed oil, by 0·06 mg. with 0·03 mg. DDT, and the increased quantity of linseed oil did not increase the toxicity of the sprayed surface.

David (W. A. L.) & Bracey (P.). **Factors influencing the Interaction of insecticidal Mists on flying Insects. Part III. Biological Factors.**—*Bull. ent. Res.* **37** pt. 2 pp. 177–190, 5 figs., 13 refs. London, 1946.

The following is almost entirely the authors' summary of this third paper of a series [*cf. R.A.E.*, B **34** 90, 156]. Experiments are described that illustrate some of the ways in which the results of exposing insects to a spray mist are dependent on either their behaviour or physiological state. *Aëdes aegypti*, L., was used throughout. Only fine mist dispersals with particles below 10 microns in diameter are considered, and in such mists the flight movements of the insects are very largely responsible for the collisions between the insect and the droplets. An increase in flight activity leads to the accumulation of a greater number of spray droplets and consequently a higher kill. Under these conditions, insecticides such as pyrethrins, which exert a strong irritating action in very small amounts, are superior against such insects as mosquitos, which frequent sheltered resting places, to DDT, which does not have this effect. For practical applications where the sprays depend on mist action, it is advantageous to mix pyrethrum with the DDT sprays so that the maximum dose of the latter may be accumulated.

Further experiments are concerned with the relative resistance of males and females of *A. aegypti* to insecticides and the change of resistance that takes place on ageing or as a result of a blood-meal. It is shown that the male is innately more susceptible to both pyrethrins and DDT and that there is a progressive decrease in resistance with age. The resistance of the females to pyrethrins is higher after a blood-meal.

Etherington (D.) & Sellick (G.). **Notes on the Bionomics of *Anopheles sacharovi* in Persia and Iraq.**—*Bull. ent. Res.* **37** pt. 2 pp. 191–195, 2 figs., 4 refs. London, 1946.

Anopheles maculipennis var. *sacharovi*, Favr, is widely distributed in Persia and Iraq in the lower part of the hill country. In 1942, T. T. Macan found it only at altitudes between 500 and 5,000 ft., but it is fairly numerous at sea level in the Shatt-el-Arab region, in isolated places in the palm belt. The immature stages occur chiefly in stagnant water, but also in running water amongst weeds. They are apparently not confined to water with a high salt content.

During September and October 1943, observations on adult density were made in a group of villages in northern Iraq. *A. m. sacharovi* and *A. superpictus*, Grassi, which bred in surrounding rice-fields and irrigation waters, were taken in stables and houses. *A. m. sacharovi*, which had occurred in very small numbers in August, continued to do so in September, but was more plentiful from the beginning of October until observations ceased on 24th. This increase in the numbers found indoors appeared to be correlated with the onset of hibernation. Development of the fat-body was first observed in females of both species about the end of September, and occurred on an increasing scale during October. Of 343 females of *A. m. sacharovi* caught between 1st and 26th October, only 20 had ovaries developed beyond stage II [*cf. R.A.E.*, B **29** 93], and ovarian development in *A. superpictus* is shown to have practically ceased during October. *A. m. sacharovi* is normally considered completely domestic, but the present findings suggest that it rests indoors less during summer than winter. It is unlikely that the increase in numbers is due to pre-hibernation migration [*cf.* **19** 123], as breeding-places were close, and there was a fair proportion of males in all catches. A rise in numbers noted later in the winter, when hibernation was complete, at villages in the Khanaqin area on the Persia-Iraq border might have been due to a migration from another locality or an influx from outside resting places. Out of 486 females dissected between November 1943 and February 1944 from a number of villages in the Khanaqin area where malaria is hyperendemic, none had gut infections but two (dissected in January) had gland infections.

A. m. sacharovi is usually associated with high malaria endemicity in Iraq and Persia, as it is in Europe [**27** 52]. However, it occurred in one area of northern Persia extending from 50 miles west to 25 miles south of Teheran in which endemicity was much lower than that recorded in other parts, though *A. superpictus* was also present. It is not thought possible that the altitude and latitude can be responsible.

A description is given of eggs with well-developed floats obtained in February 1944 [*cf.* **19** 122]. All the eggs in 22 batches from adults caught in the Khanaqin area of north-eastern Iraq, where the winter is cold, showed these characters. The float was not a constant character, nor was it well developed when present, in eggs from the warmer Shatt-el-Arab region. Points in which larvae and adults reared from eggs with floats differed from the descriptions by Hackett & Missiroli [**23** 152] are given.

[Prokopenko (L. I.).] **Прокопенко (Л. И.). An Analysis of the Causes of the severe Epidemic of Malaria in 1942 in the Urgut District of the Province of Samarkand and Measures to prevent an Increase in Malaria Morbidity in 1943.** [*In Russian.*]—*Med. Parasitol.* **14** no. 3 pp. 15–33, 5 figs. Moscow, 1945.

In this paper, which is introductory to the two that follow, an account is given of a malaria survey carried out between 9th February and 25th October 1943 in the district of Urgut (Uzbekistan), where severe outbreaks of the disease have occurred since 1937. There was a particularly serious one in 1942, when almost all the inhabitants of three villages were infected, mortality was high and agricultural work had to be suspended at the height of the season. Over half of 5,000 blood films examined between July and December in that year were positive ; all three species of *Plasmodium* were involved, though *P. falciparum* was responsible for over 63 per cent. of infection. The work in 1943 was carried out on three collective farms on which the incidence of the disease was particularly high. It was favoured by neglect of the drainage ditches, some unauthorised cultivation of rice, an increase in the size of swamps owing to a sharp rise in the level of the subsoil water, an unusual increase in the volume of

water in the main river, and malnutrition and inadequate medical treatment of the population.

The chief vectors were *Anopheles maculipennis* var. *sacharovi*, Favr. which predominated throughout the season, and *A. superpictus*, Grassi, which was abundant from June onward. The other Anophelines found were *A. claviger*, Mg. (*bifurcatus*, auct.), which was prevalent until June, and *A. algeriensis*, Theo., *A. pulcherrimus*, Theo., and *A. hyrcanus*, Pall., which were not numerous.

The ditches were cleaned and repaired in April–May, and this reduced the size of the swamps. The numbers of Anopheline larvae and adults fell sharply in May and June, but the larvae began to increase in rice plots and ponds in July and both larvae and adults became most abundant in August. Up to the end of June *A. m. sacharovi* bred almost exclusively in swamps, but from July onward 90 per cent. of the larvae together with those of *A. superpictus* occurred in rice plots and ponds. Precipitin tests showed that the Anophelines had fed mainly on domestic animals; contact with man was chiefly effected outdoors, as most of the population sleep in orchards near ponds.

Mass prophylactic treatment with acrichin and plasmocide (*cf. R.A.E.*, B **34** 178) from 28th April to 6th June resulted in a marked increase in the number of primary infections in May and June, but a dose of 0·04 gm. plasmocide (in addition to 0·3 gm. acrichin) administered for two consecutive days at intervals of five days was not effective against the gametocytes, and a further outbreak occurred in August. On the whole, however, the outbreaks in 1943 were less severe than in 1942, and mortality was much reduced.

[Ulitcheva (A. V.).] **Улитчева (А. В.). The Characteristics of Waters in which Anophelines breed in the District of Urgut.** [*In Russian.*]—*Med. Parasitol.* **14** no. 3 pp. 34–47, 13 figs. Moscow, 1945.

The topography and climate of the district of Urgut [*cf.* preceding abstract] are described. A survey there in 1943 and 1944 showed that the chief breeding places of Anophelines were, in order of decreasing importance, swamps, which constituted 96 per cent. of the total surface under water, rice-fields and ponds. The swamps are mainly fed by subsoil water and their size varied with the seasonal and periodic changes in the level of the latter. The daily mean temperature of the water ranged from 14 to 26° C. [57·2–78·8° F.] in summer and fell to 4–6° C. [39·2–42·8° F.] in January. Of the larvae of *Anopheles* found in the swamps, *A. maculipennis sacharovi*, Favr. constituted 50 per cent., and *A. claviger*, Mg. (*bifurcatus*, auct.), *A. algeriensis*, Theo., *A. hyrcanus*, Pall., *A. superpictus*, Grassi, and *A. pulcherrimus*, Theo., 30, 8, 6, 3 and 3 per cent., respectively. The seasonal prevalence of the individual species in the different types of swamps is discussed; most of them did not afford optimum conditions for the development of *A. m. sacharovi* and *A. superpictus*. The numbers of these two species per unit of surface were highest in the rice-fields, which were irrigated on the single-plot system (*cf. R.A.E.*, B **32** 171) and had a daily mean water temperature of 23–24° C. [73·4–75·2° F.]. They formed 60 and 39 per cent., respectively, of the Anopheline larvae found, other species present being *A. hyrcanus*, *A. pulcherrimus* and *A. claviger*. The same species also bred in ponds, with *A. m. sacharovi* representing 83 per cent. of the larvae. Larvae were abundant in ponds that were devoid of trees on the banks, but scarce in those that were shaded by trees, in which the water was cooler and there was no aquatic vegetation.

The measures recommended for control are drainage of the swamps by digging ditches in spring to the depth of the lowest summer level of the subsoil water, periodic draining of the rice-fields, planting trees and bushes round ponds to provide shade, and filling up of disused ponds.

[Yaguzhinskaya (L. V.).] **Ягужинская (Л. В.). Malaria Vectors in the northern Part of the District of Urgut according to Observations in 1943.** [*In Russian.*]—*Med. Parasitol.* **14** no. 3 pp. 47–56, 6 figs., 2 refs. Moscow, 1945.

Details are given of the breeding places and seasonal occurrence in 1943 of Anophelines on the three collective farms in the district of Urgut (Uzbekistan) on which malaria was severe in 1942 [*cf.* two preceding abstracts]. *Anopheles maculipennis sacharovi*, Favr, and, later in the season, *A. superpictus*, Grassi, were the chief vectors, and both were most numerous in August and the beginning of September, owing to breeding in rice-fields.

Observations on the physiological condition of the females were made throughout the season from May to October. In the case of *A. m. sacharovi*, the percentage of unfed females (stage I of Sella) was fairly constant until August, when it began to rise, reaching 75 in September and 90 in October. Females without a developed fat-body predominated in May, but those that showed slight fat development though still maturing eggs became as numerous in July. During the autumn, both these classes were gradually replaced by newly-emerged females of the overwintering generation, which are stated not to take blood and to contain fat accumulated in the larval stage or possibly as a result of feeding on carbohydrates [but *cf. R.A.E.*, B **19** 122, 123]. At the same time there was a sharp increase in the percentage of females that had not oviposited, due mainly to the presence of these overwintering individuals. The population of *A. superpictus* varied in much the same way, the percentage of females with little or no fat falling rapidly in September, and that of overwintering females with a fully developed fat-body reaching nearly 70 in October. These were in a state of gonotrophic dissociation, however, and continued to take blood, so that the percentage of unfed females in October did not exceed 30.

It is concluded that the importance of *A. m. sacharovi* as a vector of malaria decreases rapidly in September and is negligible in October, while that of *A. superpictus* is maintained so long as the temperature permits the development of sporozoites, and this was confirmed by the infection rates in autumn females. The reduction in the importance of *A. m. sacharovi* was further shown by observations on the composition of the population in day-time shelters. In September, overwintering females constituted about 50 per cent. of the population in closed and open animal sheds and 71 per cent. in native habitations. In October, however, 79 per cent. of the population occurred in closed sheds and 89 per cent. of these were hibernating individuals, whereas only 7 per cent., about half of which were hibernating, occurred in open sheds. In any case the October temperatures in both sheds and unheated dwellings were too low to permit the development of sporozoites.

[Pavlovskiĭ (E. N.).] **Павловский (Е. Н.). On the natural focal Occurrence of Tick-borne Relapsing Fever in the Turkmen SSR.** [*In Russian.*]—*Med. Parasitol.* **14** no. 3 pp. 56–59, 1 fig. Moscow, 1945.

Cases of tick-borne relapsing fever are uncommon in Turkmenistan and occur in widely separated localities. The three known vectors of the spirochaetes are *Ornithodoros tholozani*, Lab. & Mégn. (*papillipes*, Bir.), which is rare, and *O. nereensis*, Pavl. [*cf. R.A.E.*, B **32** 70] and *O. tartakovskyi*, Olenev [*cf.* **31** 58, 59], which occur in habitats where they have only exceptional contact with man [*cf.* **32** 70; **34** 72]. In June 1942, two persons developed symptoms of relapsing fever eight days after they had rested in a cave near Ashkhabad that was later found to harbour *O. tholozani*, and spirochaetes were found in the blood of one of them in mid-July. A batch of 27 nymphs taken

in the cave transmitted the infection to guineapigs on which they fed in the laboratory in August, and the survivors of the same batch (some of which had become adult) did so again in May 1943 but not in August 1944. Guineapigs were not infected by injection of suspensions of the internal organs of geckos taken in the cave. The cave also contained droppings of birds, and the presence of soot indicated that it was used by man. The ability of *O. tholozani* to live and resist starvation for many years, and to transmit the spirochaete from generation to generation [*cf.* **33** 165] ensures the preservation of foci of infection even in the absence of the animal hosts that serve as reservoirs.

[Sofiev (M. S.) & Leonova (N. A.).] **Софиев (М. С.) и Леонова (Н. А.). New Data on the Reservoirs of the Virus of Tick-borne Relapsing Fever in the Uzbek SSR.** [*In Russian.*]—*Med. Parasitol.* **14** no. 3 pp. 60–65. Moscow, 1945.

From a review of the literature, the authors show that of the animals that have been tested in Central Asia for natural infection with relapsing-fever spirochaetes, the only ones that have given positive results are dogs, the rat, *Mus* (*Rattus*) *turkestanicus*, bats, the gerbille, *Rhombomys opimus*, and hedgehogs [*cf. R.A.E.*, B **31** 59]. Investigations in June and July 1939 in the town of Ferghana (eastern Uzbekistan), which is an important endemic focus of tick-borne relapsing fever, showed that *M. musculus severtzovi* is also a reservoir, since at least 6 per cent. of 115 examples of this mouse taken in different parts of the town were naturally infected. Some of these contained numerous spirochaetes in the peripheral blood, with which guineapigs were subsequently infected; others did not, but guineapigs were infected by injection of a suspension of their brain. Seven strains of spirochaetes were isolated and were identical in pathogenicity to laboratory animals and man with the spirochaetes [*Spirochaeta persica*] isolated in previous investigations from man, *M. turkestanicus*, dogs and hedgehogs [*loc. cit.*]. In the laboratory, the mice showed symptoms for 12–28 days, and there is probably a constant interchange of spirochaetes between mice and ticks, since both occur in basements, storerooms and outhouses.

Of the 150 dogs examined, 3 harboured spirochaetes [*S. persica*] in the peripheral blood, and subcutaneous injection of blood proved pathogenic to guineapigs. *Spirochaeta latyschewi* was isolated from the gerbilles, *Rhombomys opimus* and *Gerbillus eversmanni* [*loc. cit.*].

[Pavlovskiĭ (E. N.) & Kuz'mina (L. A.).] **Павловский (Е. Н.) и Кузьмина (Л. А.). On the Possibility of the Transmission of the Spirochaetes of Tick-borne Relapsing Fever by the Tick *Ornithodorus lahorensis* to Monkeys and Man.** [*In Russian.*]—*Med. Parasitol.* **14** no. 3 pp. 66–70, 1 fig. Moscow, 1945.

The experiments described, which were made in 1936 and 1937, confirmed previous findings that *Ornithodoros lahorensis*, Neum., is not a vector of the tick-borne relapsing fever of Central Asia [*cf. R.A.E.*, B **21** 97; **23** 7, 163]. The ticks used originated from Transcaucasia and Turkmenistan. Some that fed on two baboons artificially infected with a strain of spirochaetes [*Spirochaeta persica*] from eastern Turkmenistan did not infect guineapigs on which they fed 23–68 days later, and no infection was obtained in guineapigs by injecting suspensions of the ticks into the abdominal cavity. Others that had fed on heavily infected guineapigs failed to transmit the spirochaetes to paretics by bite, and only a few could be induced to feed on them. Injection into the abdominal cavity of healthy guineapigs of a suspension of the ticks that had fed on the paretics also gave negative results.

[Troitzkiĭ (N. V.).] **Троицкий (Н. В.). The Transmission of Tick-borne Spirochaetosis by the different Stages of** *Ornithodorus papillipes*. [*In Russian.*]—*Med. Parasitol.* **14** no. 3 pp. 70–75. Moscow, 1945.

The author briefly reviews the work of other investigators on the stages in which *Ornithodoros tholozani*, Lab. & Mégn. (*papillipes*, Bir.) can acquire and transmit the spirochaetes of relapsing fever [*cf. R.A.E.*, B **25** 180; **33** 197, etc.] and gives the results of his own experiments carried out from 1928 to 1940, in which batches of larvae, nymphs or adults of this tick were fed on guinea-pigs. The results showed that all these stages can acquire the spirochaetes by feeding on infected blood, and that the spirochaetes persist in them from stage to stage, throughout adult life and from one generation to the next, and can be transmitted by bite, though a certain interval must elapse after the infecting feed. This was 1–2 months for the adults and the period required for development to the next stage or instar for the larvae and nymphs. The spirochaetes could easily be detected in larvae and nymphs during the first 4–6 days after the infective meal, but they then became much less numerous and hardly any of normal appearance were found after 20–30 days. It is not known where in the body of the tick they become localised. There was no difference in behaviour between infected and healthy ticks. In some cases no infection in guineapigs was produced by the bites of ticks known to have become infected a long time previously and to have since moulted, but the causes of this were not ascertained. Neither starvation nor feeding on healthy animals freed the ticks from spirochaetes or, apparently, decreased their virulence.

[Troitzkiĭ (N. V.).] **Троицкий (Н. В.). Experiments in the Application of Carbon Bisulphide, Chlorpicrin, Soap K and other Insecticides to destroy and repel Ticks,** *Ornithodorus papillipes*. [*In Russian.*]—*Med. Parasitol.* **14** no. 3 pp. 75–79. Moscow, 1945.

In view of the risk of outbreaks of relapsing fever among troops in Central Asia, where they occupy native dwellings, animal quarters and caves infested with *Ornithodoros tholozani*, Lab. & Mégn. (*papillipes*, Bir.), laboratory experiments were carried out to find fumigants or repellents effective for use against this tick [*cf. R.A.E.*, B **24** 263; **33** 198, 199], which usually shelters beneath dust or débris. In tests of chlorpicrin in air-tight containers, complete mortality was given by exposure to 2·5 fl. oz. per 100 cu. ft. for 30 minutes when the ticks were not protected, but 10 and 20 fl. oz. for 5–6 and 2 hours, respectively, were required when they were covered by a layer of loess 3–4 cm. deep. The high dosages necessitated by the adsorptive properties of the loess [*cf.* **33** 200] are considered impracticable, since special anti-gas precautions would be required for the operators. Paradichlorbenzene crystals applied under air-tight conditions at 25°C. [77°F.] against ticks covered with a layer of loess or sand 4–5 cm. deep gave complete mortality in 60 hours at a dosage equivalent to about 3 pints per 8 sq. yds. of floor surface. The time required was much longer when the container was not air-tight, and would probably allow some of the ticks to escape from a treated area, since their movements are accelerated by contact with the vapour. In tests with carbon bisulphide in containers that were not air-tight, the same dosage at about the same temperature killed all the ticks in 24 hours, and the fumigant penetrated a protective layer of loess 4–5 cm. deep 2–4 times as quickly as chlorpicrin and 15–20 times as quickly as paradichlorbenzene. It is suggested, therefore, that infested buildings should first be treated with carbon bisulphide, the vapours of which can be removed comparatively easily, and then with paradichlorbenzene, the slow action of which will prevent reinfestation and at the same time allow the building to be used.

In tests in which repellents or pieces of fabric impregnated with solutions of them were placed on guineapigs, the most promising was N.C.I. (94 parts naphthalene and 3 parts each of creosote and iodoform [*cf.* **29** 117]), tested in solution in benzene, but it did not afford a high degree of protection. Ticks given the choice, however, attacked a control guineapig in preference to one protected by solutions of N.C.I. or K soap [which contains dixanthogen (**31** 227)] or a tar emulsion.

[Leonova (N. A.).] **Леонова (Н. А.). On the Possibility of the Transmission by Lice of the Spirochaetes of the Tick-borne Relapsing Fever** *Sp. uzbekistanica* (*Sp. sogdianum*). [*In Russian.*]—*Med. Parasitol.* **14** no. 3 pp. 79–82. Moscow, 1945.

An account is given of experiments in Tashkent in 1940 and 1941 to ascertain whether clothes lice [*Pediculus humanus humanus*, L.] could serve as vectors of *Spirochaeta persica* (*uzbekistanica*, *sogdiana*), the causal organism of the tick-borne relapsing fever of Central Asia. Lice that had fed on man or a guineapig infected with the spirochaete were transferred in the course of the same day to non-infected men, or suspensions of them prepared at various intervals after the infected feed were injected into healthy guineapigs. All experiments gave negative results. When the stomach contents of lice that had fed repeatedly on infected men were examined at various intervals, an immobile spirochaete was observed in one batch a few hours after the last feed. To trace the fate of the spirochaetes in the lice, 20 adults were infected by rectal injection of the citrated blood of a guineapig containing a large number of mobile spirochaetes, and the contents of their intestines were examined after various intervals. Mobile spirochaetes were found in 35, 60 and 65 minutes after injection, but only immobile ones after 1½ and 2 hours, and none after 24 hours.

[Kozhevnikov (P. V.).] **Кожевников (П. В.). Absence of Cross Immunity between two Types of dermal Leishmaniasis.** [*In Russian.*]—*Med. Parasitol.* **14** no. 3 pp. 82–86. Moscow, 1945.

It is usually considered that one attack of cutaneous leishmaniasis confers a fairly stable immunity against a second, but an investigation of the history of 1,894 cases in the town of Ashkhabad (southern Turkmenistan), where both the dry and the moist types of the disease occur [*cf. R.A.E.*, B **32** 173] showed that 84 of the persons in question had contracted the infection twice, at intervals that varied from one to 49 years, and two had contracted it three times. The type of the disease in the first infection was different from that in the second in 22 cases, and could not be ascertained in the others. It appeared, therefore, that there is no cross immunity between the two types, and this conclusion was confirmed in tests in 1942, which showed that cross immunity was either absent or so weak as to permit a mild infection in people who had already suffered from the heterologous type. Each type of the disease apparently confers almost complete immunity against itself and re-infection with the same type is very rare, but two cases of re-infection with the dry type were under observation at the time of writing.

[Shikhov (N. I.).] **Шихов (Н. И.). Anti-malarial Dusting of Rice in the Phase of Flowering.** [*In Russian.*]—*Med. Parasitol.* **14** no. 3 pp. 89–92. Moscow, 1945.

In further experiments in the North Caucasus on the effect on the yield of rice of dusting rice-fields during the flowering period with Paris green and road dust for the control of Anopheline larvae [*cf. R.A.E.*, B **26** 171], different plots were

dusted at three different rates in the early morning or afternoon on each of the seven days during which the rice was in flower. The results showed no differences in yield attributable to the day of dusting, reductions that were not constant or appreciable for morning applications of 0·27 and 0·45 lb. Paris green per acre but reached nearly 13 per cent. for 0·63 lb. per acre, and considerable reductions for all applications in the early afternoon, when the flowers are open. No scorching was observed.

[Reĭngard (L. V.) & Zabud'ko-Reĭngard (T. N.).] **Рейнгард (Л. В.) и Забудько-Рейнгард (Т. Н.). The common Mayweed (*Matricaria inodora*) as a good but little studied Insecticide.** [*In Russian.*]—*Med. Parasitol.* **14** no. 3 p. 92. Moscow, 1945.

In tests with several plants that are common in the North Caucasus, the only one that showed promise as a source of insecticide was *Matricaria inodora*, the powdered dried flowers of which proved as effective in laboratory tests against *Musca autumnalis*, Deg. (*corvina*, F.) as commercial pyrethrum powder. The powdered dried leaves were ineffective.

[Barabash-Nikiforov (I. I.).] **Барабаш-Никифоров (И. И.). Contribution to the Question of the anti-Malaria Rôle of Bats.** [*In Russian.*]—*Med. Parasitol.* **14** no. 3 p. 93. Moscow, 1945.

Examination in 1939-1940 of the stomach contents of 234 bats of six species taken in the environs of Voronezh (European Russia) indicated that the larger species do not feed on mosquitos and smaller ones do so to only a slight extent.

Grenier (P.). **Les diapauses primaires et l'échelonnement des éclosions chez les simulies.**—*Bull. Soc. ent. Fr.* **49** no. 9 pp. 119–124, 1 fig., 6 refs. Paris [1945].

The author has found that development in *Simulium costatum*, Fried. [in northern France] takes 5–6 months in winter and only 5–6 weeks in summer, and that larvae of all instars occur together, very small ones being present even at the end of winter. He here gives an account of experiments made with *S. nölleri*, Fried., to determine whether development is retarded or arrested only in free-living larvae or before hatching also. Egg batches due to give rise to the summer generation were used. Leaves bearing the eggs were put in stagnant water at 20–22°C. [68–71·6°F.] and transferred to a fresh container each day. The newly hatched larvae were separated at the same time. This was easily done on account of their phototropism. Most workers agree that the egg stage in Simuliids lasts 4–6 days [*cf. R.A.E.*, B **23** 131–132], but Pomeroy found it to last 7–12 days [**4** 82] and Wu in a paper already noticed [**19** 149] recorded that whereas he only observed it to last 4–5 days at 10–22°C. [50–71·6°F.] in a natural habitat, it occupied 5–55 days in stagnant water. In the present studies, large numbers of eggs of *S. nölleri* hatched 2–10 days after oviposition, smaller numbers until about the 30th day and occasional ones until the 56th day. The first larvae had pupated before the last had hatched. The reason for this variation in the length of the egg stage has not been ascertained. It is concluded that the heterogeneous nature of populations of Simuliid larvae in both summer and overwintering generations results to some extent from differences in the time spent in the egg.

GRENIER (P.). **Remarques sur la biologie de quelques ennemis des simulies.**—*Bull. Soc. ent. Fr.* **49** no. 10 pp. 130–133, 11 refs. Paris [1945].

Natural enemies of Simuliid larvae were studied in the Paris district in breeding places where larvae and pupae of *Simulium costatum*, Fried., and *S. nölleri*, Fried., were abundant. The fungus, *Harpella melusinae* [*R.A.E.*, B **17** 128], was found in the digestive tract of about 50 per cent. of larvae of *S. costatum* of the hibernating generation. Gammarids were apparently not effective predators, as young larvae freed themselves from them after a short struggle in which the Crustaceans became entangled in silk, while larger larvae kept them away by violent movements of the head. Larvae of the Anthomyiid, *Limnophora* (*Melanochelia*) *riparia*, Fall., which was abundant with Gammarids, Oligochaetes, Ceratopogonids and *S. nölleri* in artificial waterfalls, attacked pupae of *S. nölleri* in the aquarium [*cf.* A **5** 427]. Chironomid larvae, probably *Orthocladius* sp., were found on egg masses of *S. nölleri* from the same breeding place and fed on the mucus surrounding the eggs and the micro-organisms on it. This must result in the eggs being washed away and destroyed, and it is concluded that these Chironomids are probably a far more important factor in limiting Simuliid populations than are natural enemies of the larvae and pupae. The Chironomid larvae that are often found associated with Simuliid pupae [B **33** 61] feed in a similar manner on the débris and micro-organisms that accumulate near the respiratory filaments.

MCDONALD (J.). **Annual Report of the Director of Agriculture (Cyprus) for the Year 1944.**—12 pp. multigraph. Nicosia, 1945.

In connection with the campaign for the eradication of the ox warble flies, *Hypoderma bovis*, Deg., and *H. lineatum*, Vill., from Cyprus, begun in the winter of 1938–39 [*cf. R.A.E.*, B **28** 139], examination of cattle was continued during the season of 1943–44. Only 15 cases of infestation were reported, and the four larvae that could be identified all proved to be *H. aeratum*, Aust., which normally attacks goats. From their general distribution, it is thought that the others also belonged to this species. During the following winter, eight larvae had been received up to the end of 1944 ; four of these were *H. aeratum* and the rest unidentifiable. It is therefore provisionally concluded that *H. bovis* and *H. lineatum* have been eradicated.

PAPERS NOTICED BY TITLE ONLY.

MORRIS (K. R. S.). **The Control of Trypanosomiasis** [of man and animals] **by entomological Means** [eradication of *Glossina palpalis*, R.-D., and *G. tachinoides*, Westw., by selective clearing in the Gold Coast].—*Bull. ent. Res.* **37** pt. 2 pp. 201–250, 2 pls., 3 maps (1 fldg), 5 figs., 18 refs. London, 1946. [For briefer account see *R.A.E.*, B **34** 18.]

[POMERANTZEV (B. I.).] **Померанцев (Б. И.). Les tiques (Ixodidae) de la faune de l'URSS et des pays limitrophes** [including new species]. [*In Russian.*]—*Tabl. anal. Faune URSS* no. 26, 28 pp., 25 figs. Moscow, Inst. zool. Acad. Sci., 1946. Price 1 *rub.* 50 *kop.*

FLECK (E. E.). **Report on Methods of Analysis of DDT.**—*J. Ass. off. agric. Chem.* **28** no. 3 pp. 585–589, 1 fig., 12 refs. Washington, D.C., 1945.

GÄTZI (K.) & STAMMBACH (W.). **Ueber die Nebenprodukte des technischen DDT.** [On the By-products of technical DDT.]—*Experientia* **1** no. 8 p. 276, 2 refs. Basle, 1945. [*Cf. R.A.E.*, B **34** 191.]

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ERRATA.

Page 24 6 lines from end for "cullucotton" read "cellucotton"
,, 55 6 lines from end for "*T. avis*" read "*T. avis*, sp. n.,"
,, 143 line 35 for "reduced" read "increased"
,, 156 line 2 for "H. J. Crauford Benson" read "H. J. Craufurd Benson"
,, 187 line 6 for "*A. m.*" read "*A.*"